MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

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INTRODUCTION.

The MONTHLY WEATHER REVIEW for May, 1899, is based on reports from about 3,000 stations furnished by paid and voluntary observers, classified as follows: regular stations of the Weather Bureau, 154; West Indian service stations, 10; cotton region stations, 127; corn and wheat region stations, 133; special river stations, 132; special rainfall stations, 48; voluntary observers of the Weather Bureau, 2,220; Army post hospital reports, 27; United States Life-Saving Service, 14; Southern Pacific Railway Company, 96; Canadian Meteorological Service, 32; Mexican Telegraphic Service, 20; Mexican voluntary stations, 7. International simultaneous observations are received from a few stations and used, together with trustworthy newspaper extracts and special reports.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Meteorologist to the Hawaiian Government Survey, Honolulu; the Director of the Central Meteorological and Magnetic Observatory of Mexico; Señor A. M. Chaves, Director-General of Mexican Telegraphs; Mr. Maxwell Hall, Government Meteorologist, Kingston, Jamaica; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; and Capt. J. E. Craig, Hydrographer, United States Navy.

The REVIEW is prepared under the general editorial supervision of Prof. Cleveland Abbe.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local meridian is mentioned.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

Gales of unseasonable severity did not occur on the American sea coasts and the Great Lakes during May, 1899.

Severe local storms occurred in the States of the upper Mississippi and lower Missouri valleys during the latter part of the month. The development of these storms was anticipated by the forecasts, and on the 30th, when well-marked tornadoes visited parts of Iowa and Missouri, the general forecast issued from Chicago in the morning gave warning for those States of severe and dangerous thunderstorms and squalls.

Early in the month freezing temperature was reached in the Northwestern States, and in Utah, Nevada, and northern Arizona. This condition was forecast by the Weather Bureau officials at Chicago and San Francisco. Frost warnings were not, however, issued, as vegetation was not sufficiently advanced. Warnings of frost were issued by the Portland, Oreg., office, on the 1st, 11th, 18th, and 19th, and were generally verified.

At the close of the month the San Francisco office issued rain warnings for California, Nevada, Utah, and Arizona, and although the forecasts were made during the dry season they were fully verified.

LONG-RANGE FORECASTS.

While recognizing that forecasts based upon legitimate data can not be regularly made for a period greater than forty-eight hours in advance, the Chief of the Weather Bureau has encouraged the Forecast Officials to give to the public all information regarding unusual and severe types of weather permitted by their reports and experience.

Preceding special events, a forecast for three days is of interest and often of great value to communities and districts and upon occasions to the entire country, and during periods of intense heat or cold and in the presence of drought or continued rains information bearing upon the indicated duration of existing conditions is at times of incalculable value not only to the agricultural and commercial interests but also to the public at large.

The month of May, 1899, was not marked by unusual or severe types of weather. Two events, however, called for special long-range forecasts. The first of these was made for Chattanooga, Tenn., for the period covered by an open air festival. The Chattanooga News of May 10 commented upon this forecast as follows:

The festival committee was much gratified over the weather during the festival. Nothing better could have been desired. Four days before the great event came off the committee made a request of Mr. L. M. Pindell, the Weather Bureau Observer in charge here, for a prediction of the festival weather. This was furnished to Washington and a long advance forecast three days ahead was made for the week. The prediction was verified to the letter. The committee feels under great obligations to the Weather Bureau and Mr. Pindell.

From May 23 to 25, inclusive, a Peace Jubilee was held in Washington, D. C. As this was an open air celebration, a knowledge of the probable character of the weather during the three day period which it covered was valuable to the committee on arrangements. The weather had been unseasonably warm, and this was a condition which in common with rain was not calculated to contribute to the success of the undertaking. On Monday morning, May 22, the following forecast for the District of Columbia was made:

Continued cool during the next three days; to-night will be cloudy and threatening, but generally fair weather is indicated for Tuesday, Wednesday, and Thursday; fresh northeasterly winds.

Barring a shower which passed over the eastern part of the District early Tuesday afternoon, no rain fell during the three days, the temperature conditions were ideal, and the forecast, made for a period of four days in the presence of weather conditions which were far from being settled, indicated with great exactness the character of the weather which actually prevailed during the days of the Jubilee.

CHICAGO FORECAST DISTRICT.

The month was remarkably free from severe storms. A storm moved from the Rocky Mountain region eastward to the Lakes from the 25th to the 29th, causing strong winds and thunder squalls on the upper lakes. Warning messages for high winds and severe squalls were issued to all points. At 6 p. m. of the 30th, signals were ordered up at all stations in advance of a storm which was then in the Dakotas. High southerly winds and squalls accompanied the progress of the storm across this region on the 31st.

Aside from the forecasts of freezing temperature, which were sent to the Northwestern States early in the month, the frost conditions during May were not a notable factor.

The thunderstorms which occurred in the district were, as a rule, accurately forecast, and the severe storms which occurred during the latter part of the month were well covered both in the State and general forecasts. The general forecast issued on the 30th was as follows:

The indications are that the western storm will move eastward, causing severe and dangerous thunderstorms and squalls in the Western States this afternoon and to-night, and in this section before Wednesday morning.

The press dispatches and weather reports on the following day showed that the forecast was entirely verified.—*H. J. Cox, Professor.*

PORTLAND, OREG., FORECAST DISTRICT.

A special river bulletin was issued May 6, giving the amount of snow in the mountains, and a general discussion of conditions prevailing and probability of a flood. This bulletin was distributed to interested persons and it has been most favorably commented upon.

The river forecasts cover periods of from 2 to 6 days, and all have been verified, not one being 0.5 of a foot from the height that did occur. Merchants moved goods from cellars and docks when advised to do so by this office; mills and canneries close when the river forecast indicates to the owners that danger is imminent; farmers plow on the river slope down to expected high water, and haying is commenced before the expected height is reached. Railroads strengthen bridges and embankments. All persons interested rely almost implicitly upon the river forecasts.

Frost warnings were issued on the 1st, 11th, 18th, and 19th, and were in each case generally verified.—*B. S. Pague, Forecast Official.*

SAN FRANCISCO FORECAST DISTRICT.

On May 1 a forecast was made for colder weather in Utah and Arizona; and the morning map of the 2d showed a decided fall in temperature over this district, and temperatures below freezing over Nevada, Utah, and northern Arizona. This condition continued during the 3d and 4th. Frost warnings were not issued as vegetation was not sufficiently advanced. On the evening of the 30th of May rain warnings were issued for northern California. On the morning of May 31 more complete warnings were sent throughout the entire State of California, and also to Nevada and western Arizona. In due time warnings were sent to Utah and eastern Arizona. These warnings of rain coming in the dry season, and when there were no local indications of an impending rain, received wide attention, as hay was very generally cut throughout California. The forecasts were verified in every particular, unusually heavy rains being reported on the last day of May and the first day of June throughout California.

Forecasts of rain in the desert regions were verified notwithstanding these forecasts were issued during the so-called dry season.

The rivers have been full but there have been no reports of flood or damage by overflows.—*Alexander G. McAdie, Forecast Official.*

AREAS OF HIGH AND LOW PRESSURE.

During the month the paths of six high areas and of nine low areas were sufficiently well defined to be traced on Charts I and II. The accompanying table gives the principal facts regarding the first and last appearance, the duration, and the velocity of these highs and lows. The following description is added:

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	1, p. m	43	128	6, p. m.	41	70	3,240	5.0	648	27.0
II	7, p. m.	43	107	11, a. m.	32	79	2,940	3.5	840	35.0
III	11, p. m.	46	126	18, p. m.	47	59	4,140	7.0	591	24.6
IV	17, a. m.	53	105	22, p. m.	42	72	1,860	5.5	338	14.1
V	20, a. m.	43	122	26, p. m.	32	79	3,360	6.5	517	21.5
VI	27, a. m.	52	94	29, p. m.	46	59	1,620	2.5	648	27.0
Total							17,160	30.0	3,582	149.2
Mean of 6 paths							2,860		597	24.9
Mean of 30.0 days									572	23.8
Low areas.										
I	*30, a. m.	50	119	4, a. m.	51	101	2,460	4.0	615	25.6
II	4, a. m.	52	123	10, p. m.	49	54	4,860	6.5	748	31.2
III	7, p. m.	54	116	12, a. m.	44	68	2,400	4.5	533	22.2
IV	10, p. m	52	116	14, p. m.	51	63	2,880	4.0	720	30.0
V	12, p. m.	34	114	21, a. m.	43	64	3,540	8.5	417	17.4
VI	17, p. m.	47	115	22, a. m.	35	100	1,530	4.5	340	14.2
VII	23, a. m.	43	115	28, a. m.	44	80	2,070	5.0	414	17.2
VIII	27, a. m.	39	100	31, a. m.	52	64	2,070	4.0	518	21.6
IX	29, p. m.	51	116	†2, a. m.	48	62	2,820	4.5	783	32.6
Total							24,630	45.5	5,088	212.0
Mean of 9 paths							2,737		565	23.6
Mean of 45.5 days									541	22.6

* April. † June.

Highs.—Three of the high areas began off the north Pacific coast. Nos. IV and VI were first noted in Manitoba and No. II was first seen in Wyoming. The general direction was toward the east or south of east. Nos. III and VI passed off the Nova Scotia coast, Nos. I and IV were last noted off the middle Atlantic coast, and Nos. II and V disappeared off the south Atlantic coast.

Lows.—Of the lows, Nos. I, II, III, IV, and IX were first noted to the north of Montana, Nos. VI and VII in Idaho, No. V in Arizona, and No. VIII in Kansas. The general direction was east or north of east. No. I was last noted in Manitoba, No. VI in Oklahoma, No. VII in Ontario, and the remaining six were last seen in Nova Scotia or the Gulf of St. Lawrence. The following high winds were reported in connection with these storms. On the evening of the 2d, as the last storm of April passed into the Atlantic, New York reported a northwest wind of 56 miles an hour. On the evening of the 12th, as low No. IV reached the upper Lakes, Marquette reported a south wind of 42 miles. On the evening of the 16th, as low No. V approached the Lake regions, Buffalo reported a west wind of 60 miles. As low No. VII approached the upper Lakes Chicago experienced a south wind of 56 miles. On the a. m. of the 29th, as low No. VIII approached the upper Lakes Chicago reported a southwest wind of 52 miles.—*H. A. Hazen.*

RIVERS AND FLOODS.

River conditions during the month of May were devoid of general interest. The Mississippi, below Helena, Ark., was still above danger line at the beginning of the month, but was falling steadily, and on the 10th fell below the danger line at New Orleans. The Atchafalaya remained above the danger line until the 24th, and fell slightly thereafter.

From the 7th to the 13th there was a moderate flood in the Arkansas River from the Indian Territory eastward, due to excessive rains over this portion of the river basin, Webbers Falls, Ind. T., reported a stage of 24.8 feet on the 8th, or 1.8 above danger line. The danger line of 22 feet was passed at Fort Smith on the 8th, and a maximum stage of 26.4 feet reached on the 9th. Warnings that bottom lands would be overflowed were issued on the 6th, and were fully verified.

At Little Rock the danger stage of 23 feet was reached on the 9th, and a maximum stage of 24.5 feet attained on the 11th, the waters remaining above the danger line until the 13th. A special warning for a 25-foot stage at Little Rock was issued on the 8th, and given the widest possible distribution. Levees were strengthened, and stock and other portable property removed to higher ground.

Considerable damage was done to some of the more exposed farming lands, and backwater inundated a few plantations. Below Little Rock between 5,000 and 6,000 acres of bottom lands were submerged, and 1,000 acres above.

On the Pacific coast the annual rise of the Columbia began about the middle of the month, but nothing of consequence had resulted by the end of the month.

The highest and lowest water, mean stage, and monthly range at 127 river stations are given in the accompanying table. Hydrographs for typical points on seven principal rivers are shown on the accompanying chart. The stations selected for charting are: Keokuk, St. Louis, Cairo, Memphis, Vicksburg, and New Orleans on the Mississippi; Cincinnati, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Forecast Official.*

Heights of rivers referred to zeros of gages, May, 1899.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul, Minn	1,957	14	7.6	8	5.7	27, 30, 31	6.4	1.9
Reads Landing, Minn	1,887	12	7.1	8	5.0	18, 19, 28	5.9	2.1
La Crosse, Wis	1,822	12	8.8	8-10	6.9	20	7.8	1.9
North McGregor, Iowa	1,762	18	10.8	12	7.8	23-25	9.3	3.0
Dubuque, Iowa	1,702	15	11.2	1	7.8	25, 27	9.6	3.4
Leclaire, Iowa	1,612	10	7.5	2	5.2	26	6.6	2.3
Davenport, Iowa	1,596	15	9.6	2	6.4	26, 27	8.3	3.2
Muscatine, Iowa	1,565	16	11.2	3	7.9	27	9.9	3.3
Galland, Iowa	1,475	8	6.1	22	4.4	27-29	5.2	1.7
Keokuk, Iowa	1,466	14	12.4	22	7.8	28	9.4	4.6
Hannibal, Mo	1,405	17	15.0	23	9.7	14, 15	11.4	5.3
Grafton, Ill	1,307	23	18.3	25	12.0	16	14.6	6.3
St. Louis, Mo	1,264	30	25.1	1	17.9	20	20.4	7.2
Chester, Ill	1,189	36	20.9	2	15.0	21	17.9	5.9
Memphis, Tenn	843	33	26.3	2	20.5	12	23.3	5.8
Helena, Ark	767	42	37.1	1-3	29.8	13, 14	33.4	7.3
Arkansas City, Ark	635	42	44.1	1	37.6	31	40.1	6.5
Greenville, Miss	595	42	38.4	1	31.9	31	34.5	6.5
Vicksburg, Miss	474	45	45.6	1	37.4	31	40.9	8.2
New Orleans, La	108	16	16.6	1	13.6	30, 31	15.7	3.0
Missouri River.								
Bismarck, N. Dak	1,201	14	9.1	26	4.8	7	6.2	4.3
Pierre, S. Dak	1,006	14	9.3	28	5.7	12	6.9	3.6
Sioux City, Iowa	676	19	12.4	31	8.8	15, 21, 22	10.2	3.6
Omaha, Nebr	561	18	12.4	31	9.4	16	10.7	3.0
Plattsmouth, Nebr	533	17	8.9	31	6.3	17, 19, 23, 24	7.2	2.6
St. Joseph, Mo	373	10	8.7	1	6.5	18, 19	7.6	2.2
Kansas City, Mo	280	21	18.6	1	13.2	19	15.9	5.4
Boonville, Mo	191	20	19.7	1	11.7	18, 19	14.2	8.0
Hermann, Mo	95	24	18.4	1	12.1	21	14.7	6.3
Des Moines River.								
Des Moines, Iowa	150	19	7.4	31	3.8	26-28	4.5	3.6
Illinois River.								
Peoria, Ill	135	14	8.7	1	6.7	14-16	7.5	2.0
Beardstown, Ill	70	12	11.9	30	8.5	19, 20	9.7	3.4
Osage River.								
Bagnell, Mo	70	28	18.0	12	3.9	24	6.6	14.1
Gasconade River.								
Arlington, Mo	58	16	8.3	12	—0.1	31	2.2	8.4
Youghiogheny River.								
Confluence, Pa	59	10	9.5	18	2.0	1, 29	3.6	7.5
West Newton, Pa	15	23	12.1	19	1.1	2	2.8	11.0
Allegheny River.								
Warren, Pa	177	7	3.0	4	1.2	16, 17	1.8	1.8
Oil City, Pa	123	13	5.0	18	1.6	16	2.6	3.4
Parkers Landing, Pa	73	20	6.5	19	1.3	15, 16	2.8	5.2
Monongahela River.								
Weston, W. Va	161	18	2.4	12	— 0.8	28, 29	0.4	3.2
Fairmont, W. Va	119	25	8.8	18	0.6	29-31	2.7	8.2
Greensboro, Pa	81	18	14.9	19	7.0	29-31	9.1	7.9
Lock No. 4, Pa	40	28	19.5	19	7.0	31	9.8	12.5
Conemaugh River.								
Johnstown, Pa	64	7	8.7	18	1.5	2	2.3	7.2
Red Bank Creek.								
Brookville, Pa	35	8	3.5	18	0.5	16	1.0	3.0
Beaver River.								
Ellwood Junction, Pa	10	14	7.3	18	0.6	13-16	1.2	6.7
Great Kanawha River.								
Charleston, W. Va	61	30	16.5	10	5.0	22, 23	7.5	11.5
New River.								
Hinton, W. Va	95	14	6.2	9	2.1	29	3.4	4.1
Cheat River.								
Rowlesburg, W. Va	36	14	7.5	18	2.0	29-31	3.5	5.5
Ohio River.								
Pittsburg, Pa	966	22	18.1	19	2.9	2	5.7	15.2
Davis Island Dam, Pa	960	25	17.0	19	4.7	29	7.1	12.3
Wheeling, W. Va	875	36	22.6	20	5.8	4, 29	8.5	16.8
Parkersburg, W. Va	785	36	20.0	21	7.0	28, 29	9.3	13.0
Point Pleasant, W. Va	703	39	20.6	22	5.8	30	10.9	14.8
Catlettsburg, Ky	651	50	23.8	22	8.2	30	14.6	15.6
Portsmouth, Ohio	612	50	23.1	23	9.2	31	15.4	13.9
Cincinnati, Ohio	499	50	24.0	24	11.7	31	17.4	12.3
Louisville, Ky	367	28	9.6	14	6.4	31	7.9	3.2
Evansville, Ind	184	35	22.7	16	11.8	4	15.7	10.9
Paducah, Ky	47	40	24.1	17	14.8	10	18.9	9.3
Cairo, Ill	1,073	45	34.1	1	26.4	10	30.4	7.7
Muskingum River.								
Zanesville, Ohio	70	20	12.5	30	6.4	16	7.5	6.1
Miami River.								
Dayton, Ohio	69	18	2.2	8	1.3	26, 28, 29	1.7	0.9
Wabash River.								
Mount Carmel, Ill	50	15	7.0	17	3.2	31	5.0	3.8
Licking River.								
Falmouth, Ky	30	25	6.4	14	1.4	29-31	3.3	5.0
Clinch River.								
Speers Ferry, Va	156	20	6.7	14	0.4	29	2.2	6.3
Clinton, Tenn	46	25	15.0	9	4.6	29, 30	8.2	10.4
Tennessee River.								
Knoxville, Tenn	614	28	4.8	9	0.6	29, 30	2.2	4.2
Kingston, Tenn	534	25	8.1	10	2.2	29	4.2	5.9
Chattanooga, Tenn	430	33	11.2	11	4.2	30	7.2	7.0
Bridgeport, Ala	390	24	8.5	11, 12	2.5	30, 31	5.2	6.0
Florence, Ala	220	16	7.4	13	2.4	31	5.0	5.0
Riverton, Ala	190	25	9.6	14	2.5	31	6.3	7.1
Johnsonville, Tenn	94	21	12.3	1	4.1	31	7.9	8.2
Cumberland River.								
Burnside, Ky	434	50	35.0	8	2.4	30	9.2	32.6
Carthage, Tenn	257	30	25.9	11	2.7	31	10.0	23.2
Nashville, Tenn	175	40	29.4	13	4.3	31	13.8	25.1
Arkansas River.								
Wichita, Kans	720	10	2.6	24	1.3	19	1.8	1.3
Webbers Falls, Ind. T	407	23	24.8	8	5.6	3	11.7	19.2

Heights of rivers referred to zeros of gages—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Arkansas River—Con.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Fort Smith, Ark	345	22	26.4	9	6.5	4	13.6	19.9
Dardanelle, Ark	250	21	23.5	10	7.4	5	13.3	16.1
Little Rock, Ark	170	23	24.5	11	9.4	5	15.6	15.1
White River.								
Newport, Ark	150	26	28.0	13	12.2	31	19.1	15.8
Yazoo River.								
Yazoo City, Miss	80	25	23.1	1	12.0	31	16.7	11.1
Red River.								
Arthur City, Tex	688	27	14.8	15	4.9	7	9.4	9.9
Fulton, Ark	565	28	21.5	17	8.0	5	13.0	13.5
Shreveport, La	449	29	12.6	19, 20	8.0	8	10.3	4.6
Alexandria, La	139	33	12.9	22	7.8	1	10.7	5.1
Ouachita River.								
Camden, Ark	340	39	26.9	31	9.3	5	19.1	17.6
Monroe, La	100	40	21.2	24, 25	20.0	14-18	20.7	1.2
Atchafalaya Bayou.								
Melville, La	100+	31	33.4	1	30.6	31	32.0	2.8
Susquehanna River.								
Wilkesbarre, Pa	178	14	2.2	1	0.0	10-19, 28-31	0.6	2.2
Harrisburg, Pa	70	17	5.2	21	2.5	16, 17, 29-31	3.1	2.7
W. Br. of Susquehanna.								
Williamsport, Pa	35	20	7.8	20	2.0	17	3.1	5.8
Juniata River.								
Huntingdon, Pa	80	24	......	......	......	......	.....	.....
Potomac River.								
Harpers Ferry, W. Va	170	16	9.0	19	2.3	2	3.5	6.7
James River.								
Lynchburg, Va	257	18	5.1	10	1.0	29-31	2.0	4.1
Richmond, Va	110	12	2.8	11	0.3	28	1.0	2.5
Roanoke River.								
Clarksville, Va	155	12	4.9	31	2.2	29	3.0	2.7
Weldon, N. C	90	27	11.4	13	7.8	29, 30	8.8	3.6
Cape Fear River.								
Fayetteville, N. C	100	38	17.3	15	4.2	29, 30	7.7	13.1
Lumber River.								
Fairbluff, N. C	10	6	4.7	1	2.8	31	3.8	1.9
Edisto River.								
Edisto, S. C	75	6	4.0	1-3	2.5	22-26	3.1	1.5
Pedee River.								
Cheraw, S. C	145	27	13.0	15	2.5	28, 29	5.0	10.5
Black River.								
Kingstree, S. C	60	12	5.8	1	1.7	23-31	3.4	4.1

Heights of rivers referred to zeros of gages—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Lynch Creek.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Effingham, S. C	35	12	6.6	1-3	3.2	31	4.5	3.4
Santee River.								
St. Stephens, S. C	50	12	7.9	1	4.3	31	6.7	3.6
Congaree River.								
Columbia, S. C	37	15	1.4	8	0.4	21	0.9	1.0
Wateree River.								
Camden, S. C	45	24	12.1	15	4.4	6	7.1	7.7
Waccamaw River.								
Conway, S. C	40	7	6.3	9	2.8	31	4.7	3.5
Savannah River.								
Calhoun Falls, S. C	......	......	4.0	1, 7	3.1	30	3.6	0.9
Augusta, Ga	130	32	10.4	8	7.3	31	8.6	3.1
Broad River.								
Carlton, Ga	......	......	3.2	5-7	2.5	29, 30	2.8	0.7
Flint River.								
Albany, Ga	80	20	5.4	1, 27	0.9	20-22	2.9	4.5
Chatahoochee River.								
West Point, Ga	239	20	4.8	24	3.0	22, 23	3.7	1.8
Eufaula, Ala	90	30	......	......	......	......	.....	.....
Coosa River.								
Rome, Ga	225	30	4.0	1	2.0	29, 30	3.1	2.0
Gadsden, Ala	144	18	5.4	1	1.4	29	3.1	4.0
Alabama River.								
Montgomery, Ala	265	35	9.8	1	3.0	31	5.2	6.8
Selma, Ala	212	35	13.9	1	4.2	31	7	9.7
Tombigbee River.								
Columbus, Miss	285	33	0.4	1	−1.4	31	−0.6	1.8
Demopolis, Ala[1]	155	35	7.1	3	1.8	31	3.9	5.3
Black Warrior River.								
Tuscaloosa, Ala	90	38	7.9	1	1.5	29	4.1	6.4
Columbia River.								
Umatilla, Oreg	270	25	17.1	31	7.8	6	12.2	9.3
The Dalles, Oreg	166	40	28.4	31	12.4	7	19.4	16.0
Willamette River.								
Albany, Oreg	99	20	8.4	2	5.2	18, 22	6.7	3.2
Portland, Oreg	10	15	16.8	31	8.1	7	11.5	8.7
Sacramento River.								
Red Bluff, Cal	241	23	4.8	1, 2	0.9	30	2.3	3.9
Sacramento, Cal	70	25	20.0	1	15.2	31	17.3	4.8

[1] Record for 29 days.

CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective sections of the Climate and Crop Service. The name of the section director is given after each summary.

Rainfall is expressed in inches.

Alabama.—The mean temperature was 75.9°, or 4.8° above normal; the highest was 100°, at Elba on the 18th, and the lowest, 48°, at Hamilton on the 19th. The average precipitation was 2.03, or 1.86 below normal; the greatest monthly amount, 4.80, occurred at Marion, and the least, 0.06, at Thomasville.—*F. P. Chaffee.*

Arizona.—The mean temperature was 65.8°, or 5.9° below normal; the highest was 109°, at Fort Mohave and Parker on the 12th, and the lowest, 5°, at Prescott on the 3d. The average precipitation was trace, or 0.16 below normal; the greatest monthly amount, 0.10, occurred at Holbrook, while none fell at many stations.—*W. G. Burns.*

Arkansas.—The mean temperature was 72.9°, or 3.0° above normal; the highest was 96°, at Jonesboro on the 15th, and the lowest, 44°, at Pond on the 5th. The average precipitation was 6.45, or 1.97 above normal; the greatest monthly amount, 13.36, occurred at Moore, and the least, 2.37, at Canton.—*E. B. Richards.*

California.—The mean temperature for the State, obtained by weighting the reports from 281 stations, so that equal areas have about the same weight, was 59.9°, or 4.3° below the May normal for the State, as determined from 198 records; the highest was 110°, at Volcano Springs, San Diego County, on the 13th, and the lowest, 13°, at Bodie, Mono County, on the 1st and 30th. The average precipitation for the State, as determined by the records of 298 stations, was 0.73; the deficiency, as indicated by reports from 160 stations which have normals, was 0.23 the greatest monthly amount was 4.80, at Bowman's Dam, Nevada County, while none fell at several stations.—*Alexander G. McAdie.*

Colorado.—The mean temperature was 52.2°, or 1.6° below normal; the highest was 100°, at Fort Morgan on the 25th, and the lowest, 3°, at Wagon Wheel Gap on the 3d. The average precipitation was 0.62, or 1.71 below normal; the greatest monthly amount, 2.93, occurred at Le Roy, while none fell at Perry Park and Rangely.—*F. H. Brandenburg.*

Florida.—The mean temperature was 78.2°, or 2.9° above normal; the highest was 101°, at Archer on the 18th, and the lowest, 52°, at Wausau on the 1st. The average precipitation was 1.22, or about 2.80 below normal; the greatest monthly amount, 4.03, occurred at McClenny, and the least, 0.13, at Tarpon Springs.—*A. J. Mitchell.*

Georgia.—The mean temperature was 75.2°, or 3.6° above normal; the highest was 101°, at Fleming on the 21st and 22d, and the lowest, 41°, at Diamond on the 10th. The average precipitation was 1.76, or 1.36 below normal; the greatest monthly amount, 5.44, occurred at Mauzy, and the least, 0.54, at Morgan.—*J. B. Marbury.*

Idaho.—The mean temperature was 48.4°, or 4.2° below normal; the highest was 88°, at Hagerman on the 23d, and the lowest, 6°, at Lake on the 2d and at Marysville on the 3d. The average precipitation was 1.60, or 0.49 below normal; the greatest monthly amount, 3.50, occurred at Kootenai, and the least, 0.35, at Burnside.—*S. M. Blandford.*

Illinois.—The mean temperature was 64.0°, or 1.3° above normal; the highest was 93°, at New Burnside on the 15th and at Equality on the 26th, and the lowest, 33°, at Lanark on the 21st. The average precipitation was 6.06, or 1.81 above normal; the greatest monthly amount, 13.10, occurred at Griggsville, where 5.33 fell in the storm of the 28th; the least amount, 1.84, occurred at Chester.—*C. E. Linney.*

Indiana.—The mean temperature was 64.4°, or 2.4° above normal; the highest was 96°, at Washington on the 4th, and the lowest, 36°, at Delphi on the 5th. The average precipitation was 3.95, or 0.22 below normal; the greatest monthly amount, 8.15, occurred at Vevay, and the least, 1.85, at Princeton.—*C. F. R. Wappenhans.*

Iowa.—The mean temperature was 60.2°, or slightly above normal; the highest was 90°, at Desoto on the 26th, and the lowest, 27°, at Larrabee and Spencer on the 13th. The average precipitation was 6.23, or about 2.00 above normal; the greatest monthly amount, 11.47, occurred at Keokuk, and the least, 3.09, at Ridgeway.—*J. R. Sage, Director; G. M. Chappel, Assistant.*

Kansas.—The mean temperature was 67.4°, or 3.0° above normal; the highest was 105°, at Eureka Ranch on the 14th, and the lowest, 24°,

at Colby on the 1st. The average precipitation was 3.68, or 0.38 below normal; the greatest monthly amount, 8.43, occurred at Campbell, and the least, 0.26, at Macksville.—*T. B. Jennings.*

Kentucky.—The mean temperature was 68.8°, or about 3.0 above normal; the highest was 94°, at Paducah on the 15th and at Owensboro and Williamsburg on the 16th; the lowest was 42°, at Catlettsburg, Jackstown, and Maysville on the 14th and at Owenton on the 23d. The average precipitation was 4.79, or 0.71 above normal; the greatest monthly amount, 8.16, occurred at Earlington, and the least, 2.10, at Frankfort.—*H. B. Hersey.*

Louisiana.—The mean temperature was 77.7°, or 3.5° above normal; the highest was 100°, at Liberty Hill on the 29th, and the lowest, 49°, at Mansfield on the 5th. The average precipitation was 0.98, or 2.29 below normal; the greatest monthly amount, 5.84, occurred at Plain Dealing, while none fell at Como and Lake Charles.—*W. T. Blythe.*

Maryland and Delaware.—The mean temperature was 63.7°, or normal; the highest was 96°, at Milford, Del., on the 28th, and at Chewsville, Md., on the 29th; the lowest was 31°, at Deerpark, Md., on the 21st, and at Grantsville, Md., on the 22d. The average precipitation was 3.34, or 0.86 below normal; the greatest monthly amount, 7.42, occurred at Grantsville, Md., and the least, 1.51, at Princess Anne, Md.—*F. J. Walz.*

Michigan.—The mean temperature was 56.3°, or 1.9° above normal; the highest was 91°, at Clinton, Lenawee County, on the 2d, and the lowest, 18°, at Grayling, Crawford County, on the 14th. The average precipitation was 3.72, or 0.31 above normal; the greatest monthly amount, 7.52, occurred at Calumet, Houghton County, and the least, 1.05, at East Tawas, Iosco County.—*C. F. Schneider.*

Minnesota.—The mean temperature was 55.1°, or about normal; the highest was 90°, at Milan and Montevideo on the 26th, and the lowest, 20° at Mount Iron on the 13th. The average precipitation was 4.46, or about 1.00 above normal; the greatest monthly amount, 7.99, occurred at Park Rapids, and the least, 1.51, at Lake Jennie.—*T. S. Outram.*

Mississippi.—The mean temperature was 75.0°, or about 2.5 above normal; the highest was 1.01°, at Brookhaven on the 16th, and the lowest, 50°, at Okolona on the 25th and 26th. The average precipitation was 1.81, or about 2.25 below normal; the greatest monthly amount, 5.90, occurred at Thornton, while none fell at Natchez.—*H. E. Wilkinson.*

Missouri.—The mean temperature was 66.9°, or 2.4° above normal; the highest was 96°, at Jefferson City on the 27th, and the lowest, 34°, at Elmira on the 4th. The average precipitation was 6.24, or 0.85 above normal; the greatest monthly amount, 11.38, occurred at Sublett, and the least, 3.08, at Eightmile.—*A. E. Hackett.*

Montana.—The mean temperature was 45.0°, or 4.9° below normal; the highest was 86°, at Glendive on the 25th, and the lowest, 7°, at Adel on the 3d. The average precipitation was 2.63, or 0.49 above normal; the greatest monthly amount, 6.19, occurred at St. Pauls, and the least, 0.14, at Corvallis.—*E. J. Glass.*

Nebraska.—The mean temperature was 59.6°, or 0.3° above normal; the highest was 100°, at Lynch on the 11th and at Palmer on the 27th, and the lowest, 21°, at Camp Clarke on the 4th. The average precipitation was 3.71, or 0.10 above normal; the greatest monthly amount, 8.30, occurred at Norfolk, and the least, 0.15, at Seneca.—*G. A. Loveland.*

Nevada.—The mean temperature was 49.7°, or about 5.0° below normal; the highest was 96°, at Verdi on the 10th, and the lowest, 10°, at Empire Ranch on the 3d. The average precipitation was 0.68, or about 0.49 below normal; the greatest monthly amount, 1.75, occurred at Fenelon, while none fell at Las Vegas.—*J. H. Smith.*

New England.—The mean temperature was 55.7°, or 0.4° above normal; the highest was 94°, at Claremont, N. H., and Lake Cochituate, Mass., on the 1st, and the lowest, 22°, at Flagstaff, Me., and Grafton, N. H., on the 4th. The average precipitation was 1.79, or 2.01 below normal; the greatest monthly amount, 4.12, occurred at Orono, Me., and the least, 0.32, at Concord, N. H. The drought that has prevailed during April and May has had a direful effect upon agricultural operations.—*J. W. Smith.*

New Jersey.—The mean temperature was 61.1°, or 0.3° above normal; the highest was 94°, at Paterson, Vineland, Bridgeton, and Egg Harbor on the 28th; the lowest, 29°, at Charlotteburg on the 4th. The average precipitation was 1.92, or 2.26 below normal; the greatest monthly amount, 3.15, occurred at Chester, and the least, 1.15, at Barnegat Lighthouse.—*E. W. McGann.*

New Mexico.—The mean temperature was 59.8°, or 1.7° below normal; the highest was 104°, at Eddy on the 12th, and the lowest, 11°, at Fort Wingate and Monero on the 3d. The average precipitation was 0.11, or 0.90 below normal; the greatest monthly amount, 0.60, occurred at Albert, while out of a total of 37 stations 14 reported no precipitation, and 9 only a trace.—*R. M. Hardinge.*

New York.—The mean temperature was 57.2°, or 0.7° above normal; the highest was 92°, at Penn Yan and Waverly on the 1st and at Cedar Hill on the 2d, and the lowest, 19°, at Plattsburg Barracks on the 5th. The average precipitation was 2.90, or 0.88 below normal; the greatest monthly amount, 5.07, occurred at Volusia, and the least, 0.88, at Lake Placid.—*R. G. Allen.*

North Carolina.—The mean temperature was 68.3°, or 1.3° above normal; the highest was 98°, at Southern Pines on the 3d, and the lowest, 33°, at Linnville on the 25th. The average precipitation was 3.33, or 0.85 below normal; the greatest monthly amount, 5.30, occurred at Bryson, and the least, 1.54, at Mana.—*C. F. von Herrmann.*

North Dakota.—The mean temperature was 49.7°, or 3.9° below normal; the highest was 91°, at Wahpeton on the 27th, and the lowest, 16°, at Power on the 13th. The average precipitation was 3.54, or 0.90 above normal; the greatest monthly amount, 7.79, occurred at Berthold Agency, and the least, 1.26, at Portal.—*B. H. Bronson.*

Ohio.—The mean temperature was 63.3°, or 2.4° above normal; the highest was 96°, at Logan on the 3d, and the lowest, 28°, at Wooster on the 22d. The average precipitation was 4.32, or 0.69 above normal; the greatest monthly amount, 7.14, occurred at Hillhouse, and the least, 1.64, at New Paris.—*J. Warren Smith.*

Oklahoma.—The mean temperature was 71.4°, or 3.5° above normal; the highest was 98°, at Beaver on the 14th, and the lowest, 37°, at Hennessey on the 4th. The average precipitation was 6.00, or 0.70 above normal; the greatest monthly amount, 12.30, occurred at Pawhuska, and the least, 1.35, at Beaver —*J. I. Widmeyer.*

Oregon.—The mean temperature was 49.8°, or 4.5° below normal, the lowest on record; the highest was 90°, at New Bridge on the 26th, and the lowest, 18°, at Lakeview on the 1st and at Silverlake on the 12th. The average precipitation was 2.96, or 0.13 above normal; the greatest monthly amount, 9.32, occurred at Bay City, and the least, trace, at Blalocks and Lorella.—*B. S. Pague.*

Pennsylvania.—The mean temperature was 61.1°, or 1.6° above normal; the highest was 100°, at Derry Station on the 1st, and the lowest, 24°, at Whitehaven on the 4th. The average precipitation was 3.82, or 0.86 below normal; the greatest monthly amount, 6.40, occurred at Warren, and the least, 1.15, at Lansdale.—*T. F. Townsend.*

South Carolina.—The mean temperature was 73.7°, or 2.9° above normal; the highest was 100°, at Temperance on the 18th and 19th, and the lowest, 45°, at Walhalla on the 25th and at Holland on the 26th and 29th. The average precipitation was 1.68, or 2.34 below normal; the greatest monthly amount, 3.72, occurred at Pinopolis, and the least, 0.53, at Camden.—*J. W. Bauer.*

South Dakota.—The mean temperature was 55.7°, or about normal; the highest was 92°, at Cherry Creek and Gannvalley on the 11th and at Forest City on the 29th, and the lowest, 20°, at Rochford on the 3d and at Leola on the 13th. The average precipitation was 4.45, or 1.21 above normal; the greatest monthly amount, 8.70, occurred at Aberdeen, and the least, 2.10, at Forest City.—*S. W. Glenn.*

Tennessee.—The mean temperature was 71.2°, or about 4.5 above normal; the highest was 98°, at Dover on the 15th, and the lowest, 40°, at Erasmus on the 20th and at Silverlake on the 25th. The average precipitation was 3.79, or slightly below normal; the greatest monthly amount, 6.72, occurred at Erasmus, and the least, 1.05, at Waynesboro.—*H. C. Bate.*

Texas.—The temperature on an average for the month, determined by comparison of 44 stations distributed throughout the State, was 2.8° above the normal; there was a slight deficiency over the panhandle and the mountainous portions of west Texas, while there was a general excess over the other portions of the State, with the greatest over east Texas. The highest was 103°, at Camp Eagle Pass on the 12th, and the lowest, 34°, at Tulia on the 3d. The precipitation on an average for the month, determined by comparison of 52 stations distributed throughout the State, was 0.76 below the normal. There was a general deficiency, amounting to more than 2.00 inches in many localities, except over the panhandle and the northern portion of east Texas, where there was an excess; the greatest monthly amount, 6.87, occurred at Longview, while none fell at Fort Stockton, Point Isabel, and Sabine Pass.—*I. M. Cline.*

Utah.—The mean temperature was 52.8°, or 4.4° below normal; the highest was 96°, at Pahreah on the 10th, and the lowest, 15°, at Grover on the 3d and Loa and Pinto on the 2d. The average precipitation was 0.79, or 0.58 below normal; the greatest monthly amount, 2.59, occurred at Salt Lake City, while none fell at Castle Dale.—*L. H. Murdoch.*

Virginia.—The mean temperature was 65.8°, or about 1.0° above normal; the highest was 99°, at Leesburg on the 31st, and the lowest, 30°, at Marion on the 25th. The average precipitation was 3.48 or 1.01 below normal; the greatest monthly amount, 6.75, occurred at Marion, and the least, 1.30, at Leesburg.—*E. A. Evans.*

Washington.—The mean temperature was 51.3°, or about 4.0° below normal; the highest was 88°, at Lind on the 23d, and the lowest, 16°, at Waterville on the 1st. The average precipitation was 2.85, or 0.40 above normal; in the western section there was an excess of about 1.30, while in the eastern section there was a general deficiency; the greatest monthly amount, 10.87, occurred at Clearwater, and the least, 0.05, at Connell.—*G. N. Salisbury.*

West Virginia.—The mean temperature was 64.1°, or 1.4° above normal; the highest was 96°, at Point Pleasant on the 3d, and the lowest, 35°, at Terra Alta on the 23d and at Uppertract on the 25th. The average precipitation was 5.17, or 0.86 above normal; the greatest monthly amount, 7.68, occurred at Marlinton, and the least, 3.17, at New Martinsville.—*C. M. Strong.*

Wisconsin.—The mean temperature was 55.8°, or slightly above normal; the highest was 88°, at Sharon on the 1st, and the lowest, 25°, at Florence on the 15th. The average precipitation was 4.21, or 0.40 above

normal; the greatest monthly amount, 8.47, occurred at Eau Claire, and the least, 1.08, at Lincoln.—*W. M. Wilson.*

Wyoming.—The mean temperature was 47.8°, or 2.8 below normal; the highest was 87°, at Basin on the 11th and 18th, and the lowest, 10°, at Dome Lake on the 2d and at Burns on the 3d. The average precipitation was 1.83 or 0.20 below normal; the greatest monthly amount, 4.74, occurred at Sheridan, and the least, 0.05, at Wamsutter.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

RECENT PAPERS BEARING ON METEOROLOGY.

W. F. R. PHILLIPS, in charge of Library, etc.

The subjoined list of titles has been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau:

Symons Meteorological Journal. London. Vol. 34.
——Ozone. P. 50.
Cross, Robert. Whirlwind at Worstead, Norfolk, March 20, 1899. P. 51.
Journal de Physique. Paris. 3me Série. Tome 8.
Pellat, H. Perte d'électricité par évaporation de l'eau électrisée. Vapeur émise par un liquide non-électrisé. Application à l'électricité atmosphérique. Influence des fumées. P. 253.
Comptes Rendus. Paris. Tome 128.
Bonnier, G. Caractères anatomiques et physiologiques des plantes rendues artificiellment par l'alternance des températures extrêmes. P. 1143.
Le Cadet, G. Sur l'ascension du *Balaschoff* éxécutée le 24 Mars, 1899. P. 1192.
Zeitschrift für Luftschiffahrt u. Phys. d. Atm. Berlin. 18 *Jahrg.*
Dientsbach, K. A. M. Herring's neue Flugversuche. P. 73.
Meteorologische Zeitschrift. Wien. Band 16.
Bergholz, P. Die Taifune vom 9 und 29 September, 1897. P. 145.
Edvi, E. I. v. Die Lage der Isotherme von 0° C. P. 157.
Schwab, Fr. Beobachtung eines Halo-Phänomenes. P. 164.
Schamberger, H. Sonnenringe. P. 165.
Meinardus, W. Der Eisregenfall vom 20 Oktober, 1898, über Mittel- und Ostdeutschland. P. 165.
——Beschädigung der Telegraphen- und Fernsprechanlagen im Kreise Waldenburg durch Eisbelastung und Baumbruch. P. 171.
Supan, A. Die jährlichen Niederschlagsmengen auf den Meeren. P. 173.
——Klima von Galveston, Tex. P. 173.
Hiratsuka, C. Harmonische Analyse der täglichen Variation der Deklination zu Tokio. P. 178.
Nippoldt, A., Jr. Bemerkung zu vorliegender Arbeit. P. 179.
Mazelle, E. Berichtigung zu SW.-Sturm in Triest. P. 180.
Scientific American. New York. Vol. 80.
Dexter, E. G. Crime and the Weather. P. 19592.
L'Aerophile. Paris. 7 année.
Minniot, W. Les ballons-sondes de M. Teisserence de Bort. P. 38.
Hermite, G. Le lancer de l' "Aerophile" No. 3, 24 Mars, 1899. P. 38.
Besancon, G. L'ascension du "Balaschoff," 24 Mars, 1899. P. 41.
Le Cadet, G. Sur l'ascension du "Balaschoff," 24 Mars, 1889. P. 42.
Astrophysical Journal. Chicago. Vol. 9.
Angstrom, K. Absolute Determination of the Radiation of Heat with the Electric Compensation Pyrheliometer. P. 332.
Das Wetter. Berlin. 16 *Jahrg.*
Sprung, A. Auffällige Strahlungstemperaturen. P. 83.
Clayton, H. H. Studien über cyklonale und anticyklonale Erscheinungen vermittelst Drachen am Blue Hill Observatorium. P. 85 and 114.
Fajdiga, I. Die atmosphärische Electricität und der Blitzableiter. P. 45, 69, 92, 116.
Geographical Journal. London. Vol. 13. 1899.
Cornish, V. Kumatology (Study of waves and wave structure of the atmosphere, hydrosphere, and lithosphere). P. 624.
Petermann's Mittheilungen. Gotha. Band 45.
Friedericsen, M. Meteorologische Beobachtungen in Luktschun, Zentralasien. P. 125.
Scottish Geographical Magazine. Edinburgh. Vol. 15.
Dingelstedt, V. Hydrography of the Caucasus. P. 281.
Nature. London. Vol. 60.
——Height of the Aurora. P. 130.
Ciel et Terre. Bruxelles. Vol. 7.
——Sur le phénomène de l'apparition simultanée du fœhn des deux côtés des Alpes. P. 171.
Terrestrial Magnetism and Atmospheric Electricity. Baltimore. Vol 4.
Rucker, A. W. Secondary Magnetic Field of the Earth. P. 113.

OBSERVATIONS AT RIVAS, NICARAGUA.

The records contributed for many years by Dr. Earl Flint, at Rivas, Nicaragua, include barometric readings. His present station is at 11° 26′ N., 85° 47′ W. The observations at 7:17 a. m., local time, are simultaneous with Greenwich 1 p. m. The altitude of his barometer is 36 meters above sea level, but until the barometer has been compared with a standard it seems hardly necessary to publish the daily readings. The wind force is recorded on the Beaufort scale, 0–12. When cloudiness is less than $\frac{1}{10}$, the letter "F," or "Few," is recorded.

This station is situated on the western shore of Lake Nicaragua, not far from the eastern end of the western division of the Nicaragua Canal. The volcano Ometepe, on an island in Lake Nicaragua, is about 10 miles northeast of the station. Mr. Flint's records occasionally mention the presence of clouds on the summit of this mountain.

Dr. Flint's reports to the Weather Bureau now embrace two distinct features, namely, the simultaneous morning observations and the daily climatological summary, as given in the two following tables for each month.

Simultaneous observations at 1 p. m. Greenwich (or 7:17 a. m. local) time, April, 1899.

Date.	Temperature.		Wind.		Upper clouds.			Lower clouds.		
	Air.	Dew-point.	Direction.	Force.	Kind.	Amount.	Direction from.	Kind.	Amount.	Direction from.
	°	°								
1	79	72	ne.	5	c.	10	sw.	......	......	......
2	77.5	71	ne.	4	ck.	9	sw.	k.	1	ne.
3	78	71	ne.	3	ck.	3	sw.	k.	1	ne.
4	78	71	ne.	5	......	......	......	k.	0.5	ne.
5	78	71	ne.	6	c., cs.	10	sw.	k.*	......	ne.
6	78.5	71	ne.	4	......	......	......	k.	Few	ne.
7	78	70	ne.	4	......	......	......	k.	1	ne.
8	78	69	ne.	4	......	......	......	ks.	2	ne.
9	78	70	ne.	6	ck.	10	sw.	......	......	ne.
10	76	71	ne.	4	......	......	......	k.	10	ne.
11	74.5	67	ne.	7	......	......	......	ks.	1	ne.
12	76	70	ne.	5	cs., ks.	8	sw.	f. k.	1	ne.
13	78	69	ne.	5	......	......	......	k.	2	ne.
14	76.5	72	ne.	3	......	......	......	kn.	10	ne.
15	77	70	ne.	3	......	......	......	k.	6	ne.
16	78	71	ne.	2	cs.	Few	sw.	......	......	ne.
17	79	72	ne.	3	......	......	......	k.	5	ne.
18	79.5	72	ne.	3	......	......	......	k.	4	ne.
19	80	71	ne.	2	......	......	......	k.	5	ne.
20	79	75	ne.	1	cs.	1	sw.	k.	9	ne.
21	81.5	77	ne.	1	ck.	......	sw.	k.	3	ne.
22	80.5	73	ne.	5	ck.	......	sw.	k.	10	ne.
23	79	72	ne.	6	......	......	......	f. k.	2	ne.
24	80	72	ne.	6	......	......	......	k.	5	ne.
25	80.5	72	ne.	5	cs.	2	......	k.	1	ne.
26	81	73	ne.	6	......	......	......	k.	1	ne.
27	81	73	ne.	4	......	......	......	k.	1	ne.
28	79	72	ne.	4	......	......	......	k.	1	ne.
29	79.5	72	ne.	3	cs.	......	se.	k.	1	ne.
30	78	71	ne.	4	......	......	......	f. k.	Few	ne.
Sums	......	......	......	......	......	......	......	......	......	......
Means	78.6	......	......	......	......	......	......	......	......	......

* Cumuli on Ometepe.

Climatological observations for twenty-four hours ending at 7:17 a. m. local (or 1 p. m. Greenwich) time, April, 1899.

Date.	Temperature. Maximum.	Temperature. Minimum.	Wind. Prevailing direction.	Wind. Maximum force.	Average cloudiness.	Total rainfall.
	°	°				Inches.
1	88	77.5	e.	5	10	0.65
2	87.5	79	ne.	6	6	0.00
3	88	77.5	ne.	6	7	0.00
4	87	76	ne.	7	5	0.00
5	85	76	ne.	7	7	0.00
6	88	76	ne.	6	4	0.00
7	87	75.5	ne.	6	4	0.00
8	88.5	76	ne.	6	0	0.00
9	88	77	ne.	7	2	0.00
10	87	76	ne.	9	6	0.00
11	85	76	ne.	7	7	0.00
12	89	74	ne.	7	3	0.00
13	86.5	74.5	ne.	7	1	0.00
14	88	76	ne.	7	3	0.00
15	86.2	76	ne.	5	6	T.
16	88.3	76	ne.	4	3	0.00
17	87.1	76	ne.	3	1	0.00
18	88	76	nr.	4	2	0.00
19	89	77	ne.	4	1	0.00
20	89	79	ne.	2	4	0.00
21	90	79	ne.	3	3	0.00
22	92	80	ne.	4	2	0.00
23	87	81	ne.	6	3	0.00
24	90	77	ne.	6	1	0.00
25	88.5	78	ne.	6	4	T.
26	90.5	78	ne.	6	1	0.00
27	89.2	78.5	ne.	6	1	0.00
28	90	76	ne.	6	2	0.00
29	90.2	77	ne.	4	1	0.00
30	88.3	77	ne.	3	2	0.00
Means	88.1	77.0	....	....	....	T. *

* The 0.65 on April 1, was counted in for March.

First half of month abnormal. No maximum and minimum thermometers here, but make frequent observations and infer the maximum and minimum temperatures therefrom.

Simultaneous observations at 1 p. m. Greenwich (or 7:17 a. m. local) time, May, 1899.

Date.	Temperature. Air.	Temperature. Dew-point.	Wind. Direction.	Wind. Force.	Upper clouds. Kind.	Upper clouds. Amount.	Upper clouds. Direction from.	Lower Clouds. Kind.	Lower Clouds. Amount.	Lower Clouds. Direction from.
	°	°								
1	79	72	ne.	4	ck.	6	sw.	k.	1	ne.
2	78	74	sw.	0	ck.	1	....	k.	9	sw.
3	77.5	74	sw.	0	ck.	10	sw.	....	.....	
4	76.5	73	n.-w	0	cs.	Few	nw.	....	.....	
5	78	75	s.	0	....	.....	....	k.	Few	?
6	77	74	sw.	1	....	.....	....	k.	10	ne.
7	78	74	ne.	4	....	.....	....	k.	1	ne.
8	79.5	72	ne.	3	....	.....	....	f.k.	3	ne.
9	80.5	72	ne.	5	....	.....	....	k.	2	ne.
10	79.5	70	ne.	5	....	.....	....	k.	Few	ne.
11	80	73	ne.	4	....	.....	....	ak. / k.	5 / 1	ne.
12	80.5	72	ne.	6	ck.	1	sw.	k.	1	ne.
13	80.5	72	ne.	4	....	.....	....	k.	7	ne.
14	81	73	ne.	5	....	.....	....	k.	1	ne.
15	80	73	ne.	5	....	.....	....	k.	Few	ne.
16	80.2	73	ne.	5	....	.....	....	k.	1	ne.
17	79	72	ne.	4	cs.	Few	sw.	k.	Few	ne.
18	81	76	ne.	5	cs.	Few	sw.	k.	8	ne.
19	81	74	ne.	4	....	.....	....	k.	8	ne.
20	80	73	ne.	3	cs.	2	sw.	k.	Few	ne.
21	81.5	74	ne.	5	cs.	Few	sw.	k.	Few	ne.
22	82.5	75	ne.	5	....	.....	....	k.	1	ne.
23	82	75	ne.	4	....	.....	....	f.k.	5	ne.
24	81	77	ne.	1	cs., ck.	9	nw.	f.k.	1	ne.
25	81.5	77	ne.	1	cs.	2	....	k.	8	ne.
26	79	74	ne.	3	....	.....	....	k.	10	ne.
27	78	74	ne.	4	....	.....	....	ak.	9	ne.
28	78	74	ne.	5	....	.....	....	ak, k.	6	ne.
29	77.5	71	ne.	4	....	.....	....	k.	8	ne.
30	76	70	ne.	3	....	.....	....	kn.	10	ne.
31	78	72	ne.	5	....	.....	....	ak, k.	10	ne.
Sums	.....	.....	.....	.....	....	.....	....	....	.....	....
Means	79.4	.....	.....	.....	....	.....	....	....	.....	....

Climatological observations for twenty-four hours ending at 7:17 a. m. local (or 1 p. m. Greenwich) time, May, 1899.

Date.	Temperature. Maximum.	Temperature. Minimum.	Wind. Prevailing direction.	Wind. Maximum force.	Average cloudiness.	Total rainfall.
	°	°				Inches.
1	88.1	77	ne.	4	1	0.00
2	90	77.5	ne.	4	4	0.00
3	89.5	76	ne.	3	8	0.00
4	91	77	var.	3	4	0.00
5	91.2	74	nw.	3	3	0.00
6	92	76	nw.	3	6	0.90
7	85	76	ne.	6	5	0.00
8	87	77	ne.	5	2	0.00
9	88.2	77.5	ne.	5	1	0.00
10	89	78	ne.	6	2	0.00
11	88.2	78	ne.	6	2	0.00
12	89	78	ne.	6	3	0.00
13	87	78	ne.	6	5	0.00
14	90.6	78	ne.	7	3	0.00
15	91	78.8	ne.	6	1	0.00
16	90.4	78	ne.	5	0	0.00
17	90	78	ne.	6	0	0.00
18	90.1	77.5	ne.	5	4	0.00
19	90	79.5	ne.	6	5	0.00
20	87	77.5	ne.	6	5	0.00
21	90.1	79	ne.	5	2	0.00
22	93	79.5	ne-se.	6	1	0.00
23	93	80	ne.	6	1	0.00
24	93.2	80	ne.	5	4	0.00
25	88.8	80.5	ne.	3	9	0.00
26	87	81	ne.	5	8	0.58
27	86	78	ne.	5	9	T.
28	86	76.8	ne.	6	6	0.00
29	85	77	ne.	6	7	0.10
30	83	77	ne.	5	9	0.00
31	84	75.5	ne.	6	9	0.00
Means	88.8	76.4	....	....	....	1.58

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of the Central Meteorologico-Magnetic Observatory, the monthly summaries of Mexican data are now communicated in manuscript, in advance of their publication in the *Boletin Mensual*. An abstract, translated into English measures, is here given, in continuation of the similar tables published in the MONTHLY WEATHER REVIEW since 1896. The barometric means have not been reduced to standard gravity, but this correction will be given at some future date when the pressures are published on our Chart IV.

Mexican data for May, 1899.

Stations.	Altitude.	Mean barometer.	Temperature. Max.	Temperature. Min.	Temperature. Mean.	Relative humidity.	Precipitation.	Prevailing direction. Wind.	Prevailing direction. Cloud.
	Feet.	Inch.	°F.	°F.	°F.	%	Inch.		
Culiacán Rosales (E. d. S.)	112	29.71	98.6	58.3	82.2	42	......	....	....
Leon (Guanajuato)	5,934	24.29	92.8	52.7	74.1	38	1.17	s.	e.
Linares (N. Leon)	1,188	28.59	100.4	68.0	84.6	61	0.79	s.	s.
Mexico (Obs. Cent.)	7,472	23.06	84.2	50.0	66.2	49	1.97	n.	ne.
Morelia (Seminario)	6,401	23.96	85.5	52.5	69.3	57	0.64	....	s.
Oaxaca	5,164	25.06	100.6	55.0	72.9	64	3.79	s.	e.
Puebla (Col. Cat.)	7,112	23.35	89.1	50.0	69.8	64	2.26	e.	ene
Saltillo (Col. S. Juan)	5,399	24.74	97.7	60.4	75.9	55	1.26	sw.	n.
Siloa	6,063	24.25	87.4	58.5	75.4	51	2.64	wnw.	ese.
Tuxpan	19	29.96	105.8	66.6	83.7	75	......	....	....
Zapotlan (Seminario)	5,078	25.10	91.4	53.2	74.7	67	0.77	sse.	ne.

OBSERVATIONS AT HONOLULU.

Through the kind cooperation of Mr. Curtis J. Lyons, Meteorologist to the Government Survey, the monthly report of meteorological conditions at Honolulu is now made nearly in accordance with the new form, No. 1040, and the arrangement of the columns, therefore, differs from those previously published.

Meteorological observations at Honolulu, May, 1899.

The station is at 21° 18′ N., 157° 50′ W.
Pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.
The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force or amounts of cloudiness, connected by a dash, indicate change from one to the other.
The rainfall for twenty-four hours is now given as measured at 1 p. m. Greenwich time on the respective dates.
The rain gauge, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet, and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m., Greenwich time, or 2:30 a. m., Honolulu time, of the respective dates. ‖									
				Temperature.		Means.		Wind.				Sea-level pressures.	
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.	Total rainfall.	Average cloudiness.	Maximum.	Minimum.
	*	†	†			‡	‡		§				
1	30.08	70	67.5	81	68	67.0	76	s-e.	3-0	0.03	4-10	30.10	30.00
2	30.00	71	66.5	82	68	66.0	70	se-ne.	0-3	0.00	3	30.08	30.00
3	30.06	72	67	83	68	65.0	71	ne.	3	0.05	6	30.08	30.00
4	30.06	71	65	80	70	62.5	66	ne.	4	0.00	4-1	30.11	30.08
5	30.05	72	67.5	83	71	62.7	66	ne.	3-0	0.02	2	30.10	30.01
6	30.03	72	66	82	68	63.7	68	ne.	3	0.00	5-2	30.09	30.01
7	30.05	72	66.5	81	71	63.0	67	ne.	3	0.06	4	30.09	30.01
8	30.01	73	66	81	69	64.5	70	ne.	4	0.03	7	30.10	30.01
9	29.99	72	66.5	82	72	63.0	66	ene.	4	0.03	4	30.05	29.97
10	30.02	72	66	81	70	64.7	70	ene-ne.	3-4	0.08	4	30.04	29.97
11	29.98	72	66	80	68	62.3	65	nne.	3-5	0.00	3	30.07	29.98
12	29.95	71	64.5	82	70	62.0	62	nne.	3-5	0.00	2	30.03	29.93
13	29.94	68	64	82	70	61.3	62	nne.	3	0.00	2	30.01	29.90
14	29.96	72	66	81	66	62.0	66	nw-ne.	3-0	0.00	4	29.99	29.90
15	29.95	71	66.5	82	65	62.7	66	ne.	3	0.02	4-9	30.01	29.95
16	29.96	71	66.5	82	71	63.7	68	ne.	4	0.18	3-7	30.01	29.95
17	29.97	70	67.5	80	69	64.7	71	ene.	3-0	0.30	7	30.00	29.94
18	29.91	67	66	74	68	68.3	88	w.	1-0	0.86	10	29.99	29.91
19	29.90	69	67	81	66	66.5	83	sw-w.	0-2	0.00	2-8	29.96	29.80
20	29.91	68	67	77	66	66.5	84	s.	2-0	0.29	10-8	29.96	29.91
21	29.95	71	68.5	81	68	65.3	81	se-ne.	0-4	0.01	8-10	29.99	29.91
22	29.97	74	68.5	84	67	66.5	82	e-ne.	1-4	0.00	5	30.03	29.95
23	30.01	73	66	80	73	64.5	68	ne.	5	0.04	4	30.05	29.98
24	30.06	74	65	80	72	62.5	65	ne.	5	0.03	5	30.09	30.01
25	30.03	73	65	80	73	61.0	61	ne.	5	0.00	5-10	30.11	30.03
26	30.03	72	66	76	72	61.7	66	ne.	4	0.17	10-8	30.09	30.02
27	30.05	72	65	77	71	63.3	70	ne.	5	0.20	8-3	30.11	30.02
28	30.03	73	66	78	71	61.7	65	ne	4-6	0.02	5	30.09	30.03
29	30.05	73	66.5	80	71	61.5	63	nne.	5-4	0.00	3	30.09	30.02
30	30.10	73	65.5	80	72	62.7	65	nne.	5-4	0.02	6	30.14	30.05
31	30.08	73	65	82	71	62.7	64	ne.	4	0.00	8	30.14	30.08
Sums	......	......	......	......	......	......	......	....	.....	2.44	......	......	......
Means	30.003	71.5	66.2	80.5	69.5	63.7	69.5	....	3.0	....	5.1	30.058	29.980
Departure	—0.004	......	......	......	......	0.0	—1.0	....	.....	—0.50	+0.4	......	......

Mean temperature for May, 1899 (6+2+9) ÷ 3=74.2°; normal is 74.2°. Mean pressure for May (9+3) ÷ 2 is 30.017; normal is 30.021.
* This pressure is as recorded at 1 p. m., Greenwich time. † These temperatures are observed at 6 a. m., local, or 4:30 p. m., Greenwich time. ‡ These values are the means of (6+9+2+9) ÷ 4. § Beaufort scale.
‖ Possibly this record is for 9 a. m., Honolulu time.

MONTHLY REPORTS OF THE WEATHER BUREAU SERVICE IN THE WEST INDIES.

By WM. B. STOCKMAN, Forecast Official.

(The following is an abstract of Mr. Stockman's report for April, 1899.)

So far as general storms are concerned the conditions remained normal throughout the month. The following is a brief résumé of the meteorological conditions at the central station at Havana:

The a. m. barometer, 30.03, and the p. m., 30.01, each appear to be .04 inch above the normal. The highest was 30.22 on the 11th, and the lowest, 29.89, on the 20th. It was somewhat below the normal from the p. m. of the 16th to a. m. of the 22d, inclusive, and from a. m. of the 27th to p. m. of the 30th, inclusive.

The former depression was attended by a wind velocity of 30 miles northwest, and .69 inch of rainfall on the 18th, and .01 inch on the 21st. The latter depression was not attended by rain or high winds.

The following comparisons of temperature and rainfall are made with the ten years (1888–1897) mean, given in Weather Bureau Bulletin No. 22, Climate of Cuba:

TEMPERATURE.

	Monthly.	2 a. m.	4 a. m.	6 a. m.	8 a. m.	10 a. m.	Noon.	2 p. m.	4 p. m.	6 p. m.	8 p. m.	10 p. m.
	°	°	°	°	°	°	°	°	°	°	°	°
Mean	76.1	74.0	70.0	69.6	78.4	79.5	81.2	81.1	80.8	77.9	75.2	73.8
April, 1899	74.0	70.2	69.5	69.1	72.6	77.5	78.6	78.5	77.7	75.9	73.9	72.9

The average for 1899 is 2.1° lower than the mean, and the average temperature at various hours is from 0.5° to 3.8° lower than the mean at the same hours.

Absolute maximum	93.6° in 1895.
Maximum, April, 1899	88.0° on the 7th.
Absolute minimum	52.9° in 1891.
Minimum, April, 1899	62.4° on the 12th.

Showing the maximum and minimum in the month to have been respectively, 5.6° lower, and 9.5° higher than the extreme recorded in the decade.

Rainfall compared with a 10-year period:

Mean	1.46 inch.
Total, 1899	.70 inch.
Greatest	5.67 inches in 1897.
Least	0.00 in 1896.
Greatest in 24 hours in April, 1899	.69 inch on 18th.

Number of days with rain.

Mean, 3.8; maximum, 9; minimum, 0. Total, 1899, 2; one with 0.69 inch and one with 0.01, besides which there were 4 with traces, less than 0.005.

The month of April, 1899, shows a departure from the normal of —0.76 inch, and the number of days with rain, .01 inch or more, being about 53 per cent of the average.

In the period 1859–1897, inclusive, the average monthly rainfall is 2.83 inches, and the average number of days with rain, 1863–1897, is 4.6; both amount and number of days with rain being greater than the decade 1888–1897.

For the month of April the prevailing direction of wind is east, and the average hourly velocity is 9.2 miles. April, 1899, gave a total wind movement of 8,219 miles; average velocity, 11.4 miles, and a prevailing direction of northeast, 29 per cent; east being 24 per cent, and northwest, 18 per cent. The percentage of miles was for the northeast 42 per cent; east, 12 per cent, and northwest 22 per cent. The average hourly velocity of wind, 11.4, equals the mean highest average hourly velocity, 2 p. m., as shown by Weather Bureau Bulletin No. 22.

Following is a comparison of the average hourly velocity, with the mean at various hours:

	Mean.	4 a. m.	6 a. m.	8 a. m.	10 a. m.	Noon.	2 p. m.	4 p. m.	6 p. m.	8 p. m.	10 p. m.
Mean	7.5	4.3	4.5	6.5	9.2	10.7	11.4	10.7	8.7	6.9	5.6
April, 1899	11.4	6.4	7.0	8.2	13.2	14.2	16.6	17.3	16.1	12.9	9.8

From which it appears that the April, 1899, average velocity, at the several hours, was from 1.7 miles to 7.4 miles per hour greater than the mean, and the higher average hourly velocities occurred at later hours than the higher mean. The highest average hourly velocity for April, 1899, was 17.4 miles at 3 p. m., and the lowest average hourly velocity, 6.4 miles from 2 a. m. to 5 a. m.

The following high winds occurred during the month: 6th, 28 miles ne.; 7th, 30, se.; 8th, 26 nw.; 9th, 27 nw.; 11th, 32 ne.; 12th, 30 ne.; 13th, 33 ne.; 14th, 31 ne.; 18th, 30 nw.; 23d, 30 ne.; 24th, 27 ne.

The possible sunshine for April varies from 12.4 hours on the 1st to 13 hours on the 30th. During April, 1899, the sun

shone 61 per cent of the possible, an average of 7.7 hours per day.

The following is an abstract of Mr. Stockman's report for the month of May:

No general storms known to have occurred. Certain weak barometric depressions, with slightly increased wind and rain occurred on the 1st, 2d, 3d, and rather high winds occurred at Havana on the 1st, 6th, 7th, 15th, 16th, 17th, 24th, 25th, 29th, 30th, and 31st. None of these winds could be considered as anything but the regular northeast trades, except the squalls of the 1st, 24th, and 25th; the last attended a thunderstorm and heavy rain. No damage was done by the wind.

Hail was reported at Santa Clara on the 26th. On the 21st a whirlwind occurred 12 miles from Pinar del Rio and passed from east to west, doing no damage.

The following comparisons are made between a ten years' (1888 to 1897) mean and May, 1899:

	Temperature.		Rainfall.	
	10-year mean.	1899.	10-year mean.	1899.
Mean monthly	78.8	76.8		
Absolute maximum in 1890	97.9	88.7		
Absolute minimum in 1889	64.4	66.1		
4 a. m	72.7	71.4		
6 a. m	72.9	70.5		
8 a. m	78.8	75.7		
10 a. m	82.8	82.0		
12 noon	83.1	82.8		
2 p. m	83.3	81.8		
4 p. m	82.8	80.6		
6 p. m	80.4	79.5		
8 p. m	77.5	77.9		
10 p. m	76.3	76.2		
Mean monthly			5.15	1.64
Greatest amount in twenty-four hours			6.27	1.35
Average number of rainy days			9.9	4
Greatest number of days with rain			16	
Least number of days with rain			3	

This table shows that the mean temperature for May was 2° lower than the ten years' normal, the maximum 9.2° lower than the absolute maximum; minimum 1.7° higher than the absolute minimum, and the mean temperature at the selected hours from 0.1° to 3.1° lower than the normal.

The rainfall for the month was greatly deficient, being —3.51 inches from the ten years' normal and —2.83 inches from a thirty years' period. The number of days on which rain fell was but one more than the least recorded in a ten years' period. The average monthly rainfall for a thirty years' period is 4.47 inches, and average number of days with rain 9.3 inches, both of these averages being less than the average for a ten years' period.

Wind.

	Mean hourly velocity.	Annual hourly velocity.										Prevailing direction.
		4 a. m.	6 a. m.	8 a. m.	10 a. m.	12 noon.	2 p. m.	4 p. m.	6 p. m.	8 p. m.	10 p. m.	
Annual	7.8*	4.3	4.5	6.5	9.2	10.7	11.4	10.7	8.7	6.9	5.6	e.*
May, 1899	11.0	4.9	4.8	6.2	10.9	16.0	18.8	18.7	17.1	13.3	9.8	ne.

* 10-year mean for May.

From the above, it will be seen that the hourly averages for May, 1899, differ from the annual hourly by from —0.3 at 8 a. m. to +8.0 at 4 p. m. With the exception of 8 a. m., all averages are higher, and the high average velocities continued much later in the day. The total number of miles for the month was 8,219.

THE UTILIZATION OF FOG.

By FORD A. CARPENTER, Observer Weather Bureau, San Diego, Cal.

A cursory examination of our local meteorological conditions is given in a paper in the MONTHLY WEATHER REVIEW for March, 1899, pages 101–102, by Mr. A. McL. Hawks, C. E., Tacoma, Wash., on "The Utilization of Fog." Mr. Hawks says:

I spent March to May, 1898, in San Diego. The country was absolutely arid; no rain of import had fallen in eighteen months, the streams were dry, the huge reservoirs were almost empty, ranches were barren, wheat fields burnt up, cattle driven out of the State, fruit trees dying for lack of water. And yet almost every evening (I think safely three out of five) tons upon tons of water rolled in from the ocean over the land, hung there all night long, only to evaporate in the a. m. with the parched land almost as thirsty as before its visit. The diurnal cycle usually reads thus: at about 10 a. m. a sea breeze springs up, blowing 12 to 20 miles per hour from the west, with the sun shining as it only can shine in the arid countries; at 5 p. m. the breeze falls until by 6 p. m., it is usually gone so entirely that the sailors method of licking a finger to detect the direction of the wind fails to find any stirring. As the breeze dies down a bank of fog forms out over the ocean and rolls shoreward. This is usually about 500 feet deep. And when it strikes Point Loma dashes up into the air like spray from a rock. Long after the wind dies out the fog continues to roll inland until it finally reaches the hills 1,000 to 1,500 feet elevation and 25 to 40 miles inland. Rarely in the evening does it climb to the summit of these hills (2,000 to 3,000 feet elevation), though usually it rolls over them before morning. By 8 p. m. the grass is quite wet; all night long this bank lies over the the land. Soon after sunrise, generally about 8 a. m., the breeze springs up from the west, and by 10 a. m. the conditions are exactly the same as on the preceding day.

To one accustomed to the verdure of a well watered country, San Diego County ordinarily presents an arid appearance. Dependence is placed entirely upon irrigation, the natural precipitation being insufficient for any except the scanty vegetation of the desert. The rainfall of the higher elevations of the country is stored and used when necessary. During the eighteen months preceding March, 1898, in which period Mr. Hawks stated that "no rain of import had fallen," 15.74 inches, or 80 per cent of the normal precipitation had actually occurred. The natural state of the streams in San Diego County is that of dryness, the old joke about the rivers running upside down becomes a verity, as steadily flowing wells near the sunken river beds prove. The farmer accustomed to green looking hay would be shocked to see stock fattening on what appears to be the straw from "wheat fields burnt up." Instead of "cattle being driven out of the State" when pasturage fails on the lower coasts, they are simply moved 10 or 20 miles inland to higher elevations, where the rainfall is from four to five times greater than in the country bordering the coast. Fruit trees growing out of hard clods of sun-baked soil appear truly artificial, but no case of "fruit trees dying for lack of water" has yet come to my notice.

As to the sunshine and the implied high temperature, "the sun shining as it only can shine in the arid countries," I find that in point of fact, the mean of the highest temperatures for the three months was 62° in March, 65° in April, and 63° in May.

As to the strength of the wind, the article is again in error, for the records for the months under consideration, show an average velocity of 10 miles per hour from the sea and 5 from the land.

During this period there were two days with an hour or more of fog in March, six in April, and none in May: total eight. Possibly the memory of one night's fog, that of April 26, 1898, when it was as dense as a moist rain, depositing a trace in the rain gauge and causing the metal roofs of buildings to drip with moisture was indelibly fixed in the mind of the writer of the article: and was also responsible for the reference to fog on "3 days out of 5." There have been instances of deposits of water of 0.01 to 0.05 inch due to fog, but these occurrences are rare, not happening oftener than once

a year on an average. Since the establishment of this station in 1871, the mean number of foggy days dense enough to obscure objects a thousand feet distant has averaged nine for the entire year in San Diego.

During the late spring and early summer months the moisture-laden sea breeze carries over the land, not "tons upon tons of water," but of vapor that is visible as stratus cloud at from 500 to 1,000 feet altitude, and the cloud layer is so thick as to modify, and in some instances practically nullify insolation. At such times the sunlit bases of the mountains, 15 to 20 miles distant, beyond the cloud layers, can be readily seen. The temperature beyond the low cloud limit is frequently from 25° to 30° above the temperature at San Diego. That the thick stratus cloud presents quite an obstacle to the sun's rays is shown by the thermograph trace, which, during these not infrequent days, registers a horizontal line with but two or three degrees variation. This cloud is locally known as "high fog," which is but a popular definition of stratus cloud. The relative humidity near the earth is about normal during these times, ranging from 70 to 80 per cent.

Fog at the ground level is beneficial to orchards only in so far as it freshens the leaves and prevents evaporation from the soil. That it can never do much to supplement irrigation, nor the direct work of rainfall in watering the soil, is apparent when the infrequency of fog dense enough to deposit even 0.005 of an inch is considered. In addition to the normal rainfall of 10 inches, about a quarter of a million gallons of water for each acre is needed annually for citrus fruit. Allowing 80 trees to the acre, it is readily seen how insignificant the water condensed from a few foggy nights would be to a tree requiring more than 3,000 gallons as an annual water supply.

THE FLOOD OF JANUARY, 1880, AT BASSETERRE, ST. KITTS, W. I.

By WILLIAM H. ALEXANDER, Observer, Weather Bureau.

While strolling one morning along the streets of this city the writer's attention was attracted to a plain, massive monument in the cemetery on which he read the following inscription: "Sacred to the memory of those who perished in the flood in Basseterre, St. Christopher, on the 12th of January, 1880, and commemorative of that awful visitation, in which 231 persons lost their lives, of whom 101 are buried here."

Beyond the mere facts as to dates and results, as set forth in the above inscription, there seems to be no official record bearing on the event, and I have compiled the following lines by the help of the memory of eyewitnesses:

It seems there were no premonitory signs of the impending disaster further than toward sunset an unusual warmth was felt which continued up to 9 o'clock p. m., when "an intense cold set in," then a light shower of rain fell. The clouds gathered early in the evening, and very soon the city was enshrouded in intense darkness. "The darkness could almost be felt."

Occasional flashes of lightning accompanied by "deep rumbling thunder" now and then relieved the painful feeling. About 11 o'clock the rain began again, and eyewitnesses say it "looked like sheets of water pouring out of the clouds." Soon the place was flooded, and ere long the water began to creep into the houses, to the great consternation of the inmates, who, upon attempting to escape, found the streets like rivers, making egress not only unsafe but well-nigh impossible. Those who were so fortunate as to possess an "upstairs" availed themselves of the security afforded by a more elevated position, but unfortunately the great bulk of the population lived then, as now, in little one-story, one-roomed houses (if one can call them houses at all) built of light material and loosely put together, so that soon houses and all began to move seaward. The rain continued for about four hours, resulting as above indicated in the drowning of 231 persons certainly, and possibly more, beside the loss of property.

Many were buried beneath a layer of mud several feet deep that came down from the fields and mountains.

Of course, all gages and marks by which the amount of the precipitation could be measured or estimated, were either swept away completely or entirely submerged, and only individual opinions on this point can now be had. It is estimated that 23 inches fell within the four hours, and this augmented by the overflowing of the mountain streams, caused the great destruction of life and property. As in the days of ancient Babel so these people have attempted to fortify against any further disaster of this kind, not by erecting a tower but by encircling the city with a stone wall intended to check and divert the mountain streams into other channels.

[It is very much to be desired that the observers, located at stations whose climate is but little known to the citizens of the United States, should compile brief abstracts of all available records bearing on the climatology of such locations, especially matters affecting commerce, agriculture, and hygiene, or instructive from the point of view of the theoretical meteorologist. It requires much previous reading and study to prepare oneself for profitable scientific work when traveling into distant regions. Our observers at isolated stations, who are perhaps not confident of remaining long at any one place, can best begin their local studies by the collection of past records and by personal acquaintance with older local observers. Original manuscript records of work done in the tropical regions are very likely to be destroyed by mold and insects, even if not lost through neglect. The preservation of these original records is highly desirable, as they have never or rarely been published in full and contain the data for many important researches. Such manuscripts are doubtless worth asking for with a view to their future preservation in the fireproof vaults of the Weather Bureau. Many stations recently occupied by the Weather Bureau have also been previously occupied by other observers, and for the sake of the continuity of record, it is vitally important to institute a careful comparison between the old and the new instruments and the peculiarities of their respective localities.—ED.]

DERECHO, NOT TORNADO, OF MAY 16 IN OHIO.

By J. WARREN SMITH, Section Director.

At about noon on May 16 a wind squall entered northwestern Ohio and passed eastward across the State at the rate of about 50 miles an hour. It unroofed and damaged many buildings, leveled fences and a large number of oil derricks, and broke down orchard, shade, and forest trees.

The first damage noted in this State was in the western part of Gorham township in Fulton County, where a school house was blown down and several pupils injured. The following items from the teacher, Miss Fisher, will prove of interest:

The building in which I was teaching was a brick structure, put up in the cheapest possible manner, size about 28 by 34. The storm came up from the west and traveled in a southeasterly direction, the wind being from the southwest. It had the appearance of an ordinary heavy rain and wind storm. The storm had passed to the north when the wind turned to the northwest. It blew straight ahead as was conclusively proven by the fact that it did not pick up anything from the ground, not even disturbing a stick of wood on the wood pile. The wind seemed to dip and sweep the ground for 50 or 100 rods, then rise and pass over a mile or more, then fall again. I have no definite idea of the velocity of the wind, but it blew very hard and lasted one or two minutes; it was acompanied by a deluge of rain. The school building was a complete wreck, valued, together with its contents at about $1,000. There were 25 scholars within, of whom 5 were seriously and 8 slightly injured.

The voluntary observer at Wauseon, Fulton County, states:

A heavy thunderstorm, with high wind, struck here just after noon, filling the air with sand so I could not see 15 rods. Some trees were broken down and two barns unroofed, one two miles east of here and the other four miles northwest. It was not a tornado, but a straight wind.

Wauseon is about 17 miles southeast of the schoolhouse mentioned above.

At Toledo the wind was 44 miles an hour from the northwest.

At Cleveland the maximum on that day was 58 miles from the west.

The observer at Green Spring, in Seneca County, writes:

Its path was about three-eighths mile wide at some points; one-half mile at others.

Mr. W. F. Miller, of Siam, Seneca County, writes:

The storm struck here at 2 o'clock. A number of barns were unroofed at a point three miles east of Bloomville. The wind was a straight blow, with no hail. The clouds were of a light yellowish green; lightning accompanied the storm.

He incloses a diagram which showed that the storm moved southeasterly, and that there were points of greatest severity at irregular distances of from one to five miles apart.

Prof. H. V. Egbert, voluntary observer at Bouchtil College, Akron, Summit County, writes as follows:

The storm was not of a tornado character. It had been raining a little, with light wind from the southwest, when it suddenly shifted so as to come from the north 60° west. It reminded me very much of the wind which frequently springs up after a thunderstorm when the low has passed and the northwest wind sets in vigorously. There were low clouds and some darkness therefrom, but they were clouds of smoke which had settled over the city and as soon as they blew away it was lighter. The nimbus were at an average height and they disappeared with the approach of the wind, leaving the higher stratus, from which no rain fell. In other words, the wind was not accompanied by rain. There was no joining of clouds, as is supposed to exist in a tornado. I saw the whole affair from the third story of the college building, which stands on the highest ground in the city. There was no lightning, though in the night following a thunderstorm occurred. It was simply a good old-fashioned straight blow, though a severe one.

Reports from voluntary observers in Portage, Mahoning, and Columbiana counties show considerable local damage, Mr. T. R. Snowden, postmaster at Wellsville in Columbiana County, writes:

The damage done in this section was caused by the wind alone. The wind had a twisting movement, uprooting trees and catching up great quantities of water from the river and scattering it in spray.

Newspaper reports indicate that the west gable of a schoolhouse which stood in the Keefer District near Canal Fulton, Stark County, was blown in and several of the pupils seriously injured. This occurred at 3:15 p. m.

Other damaging thunder and hailstorms occurred later in the afternoon and evening over the same district. In southern Wayne and northern Holmes counties, hail destroyed much glass, broke slate, perforated iron roofs, and killed some sheep.

Some interesting facts in connection with this storm are:

(*a*) The storm occurred in the northeast quadrant of a cyclonic area, yet had the characteristics of a "line" squall, such as occur near the western edge of a sirocco wind area, where the overrunning colder winds cause the most unstable condition of the atmosphere.

(*b*) The absence of the generally-accepted characteristics of the tornado, although most newspapers and some observers gave it that name. A study of its course shows that it was widespread, covering much more territory than is ever covered by a tornado.

(*c*) The apparent rising from and dipping down to the earth of the severest winds.

(*d*) The meteorological conclusions announced by the newspaper reporters and the universal exaggeration of accounts of damage were more remarkable than usual.

BALLOON ASCENSIONS ON MARCH, 24, 1899, IN FRANCE.

[Abstract from L'Aerophile, April, 1899, by Prof. F. H. BIGELOW.]

On March 24, 1899, five balloons were sent up in France, three, unmanned, under the direction of M. Teisserenc de Bort; one, unmanned, in charge of M. Gustave Hermite, and one, manned, carrying MM. Bezançon et Le Cadet. The results of these ascensions were interesting on account of several practical experiences, which it will be well for those planning such voyages of exploration in the upper air to bear in mind.

(1). The first unmanned balloon was of 100 cubic meters. It was launched by M. Raymond, at Trappes, about 8:30 a. m. It drifted east-northeast and landed at Treves, in Rhenish Prussia. At the altitude of 14,000 meters, when the surface temperature was —1.9° C., the balloon thermometer recorded —52.9° C., a fall of 0.364° per 100 meters.

(2). The second balloon, of the same size, was launched by Teisserenc de Bort, near Limoges, at 9.27 a. m. It moved north-northeast 59 kilometers and landed at Péroles (Corrìze). At the height of 8,600 meters, for a surface temperature of +0.3° C, the temperature —44.0 C. was registered at the balloon, a fall of 0.515° per 100 meters.

(3). The third unmanned balloon, also 100 cubic meters in size, was launched by Teisserence de Bort, at 3.45 a. m., from the same place, and it moved 121 kilometers east to Meix-Saint-Epoin (Marne). For a surface temperature of —3.0° C. the temperature at the height of 8,600 meters was —52.6°, a fall of 0.570° per 100 meters. The last balloon was sent up before sunrise, in order to determine what influence the sun's rays would have upon the registering thermometers as compared with the similar instruments sent up at 9.27 a. m. The latticework used to protect the thermometers was quite sufficient for this purpose, and the conclusion is drawn that no complicated mechanism is required to agitate the air near the thermometers at high altitudes.

(4). The fourth unmanned balloon, the Aerophile, No. 3, 460 cubic meters capacity, had a disastrous experience. It was sent off by M. Gustave Hermite, from the Champ-de-Mars, but was only *one-third* filled with gas, thus saving expense. It was supposed that the gas would expand at high altitudes enough to completely expand the balloon. It ascended 4,000 meters, meanwhile taking on the form of a parachute, resisting the movement of the balloon upward. It was subjected to violent swayings and shocks, and at that height burst into a thousand pieces, as if the covering had been made of brittle glass, falling near Bagneux (Seine). It is supposed that the low temperature froze the material and made it very fragile, or that possibly a rope became twisted about the globe, preventing its proper enlargement. This experience is considered conclusive against the idea that an unmanned or sounding balloon may profitably be started up only partially filled with gas. On recovering the instruments, it was found that with a surface temperature of 0° C., the temperature at the height of 4,338 meters was —33° C., a fall of 0.700 C. per 100 meters.

(5). The manned balloon was the "Balaschoff," carrying M. M. Besançon and Le Cadet, which left Paris at 8:15 a. m. and landed at Loiret (Seine-et-Marne) at 11:15 a. m. For a surface temperature of —3.4° at the height 4,014 meters a temperature of −31.6° was observed, being a fall of 0.732° per 100 meters. They had a mercurial barometer, but it was found impossible to read it very accurately on account of the incessant oscillations of the balloon, and they conclude that this difficulty is so persistent in balloon voyages that either the aneroid or self-registering instruments must always be employed. The ventilated Assmann psychrometer was suspended at the end of an arm, 12 feet from the balloon, and it was read by a telescope. The self-register thermograph which agreed with the Assmann at the ground recorded

about 4° lower at the high altitudes. This lag of the self-register is a serious defect in all ascensional operations, and it should be carefully considered before drawing conclusions from such data. In this ascension the wet-bulb thermometer seems to have ceased to operate at the temperature —22° C., and after that it actually read warmer than the dry-bulb thermometer. This shows the extreme unreliability of all direct measures of humidity at very low temperatures in the free air.

Besides giving us some interesting low temperature readings at several high elevations, these experiences show what should be avoided in several particulars, especially in starting up with a partially inflated balloon.

CLIMATOLOGY OF THE ISTHMUS OF PANAMA, INCLUDING THE TEMPERATURE, WINDS, BAROMETRIC PRESSURE, AND PRECIPITATION.[1]

By HENRY J. ABBOT, Brigadier General, U. S. A. (retired).

In his note on this subject dated Paris, June, 1882, Monsieur Cugnin enumerated the astronomical and physical conditions which produce important consequences as to local climate. The following are some of these conditions:

General considerations.—The geographical position of the Isthmus of Panama is about 9° north latitude. From this position it follows that at noon the sun is in the zenith twice a year; it is on the northern side between the 13th of April and the 29th of August. Its altitude above the north horizon on the day of the summer solstice is 75° 41′ and its altitude above the south horizon at the winter solstice is 57° 24′. It transmits to the surface of the earth the maximum possible amount of heat on April 13 and August 29. The amount of heat coming from the sun is in proportion to the sine of the angle made by the solar rays with the horizon; that is to say, to the numbers 1.00, 0.97, and 0.84 at noon at the time of the maximum and at the two periods of summer and winter minima, respectively. This shows the very small differences in the quantity of heat received day by day during the entire year.

But the temperature of the air does not depend solely upon the quantity of heat coming from the sun, it is also necessary to consider the amount lost by radiation and the effects of many local conditions, and these may vary according to place and from one day to another. Among these conditions the motions of the atmosphere and the quantity of aqueous vapor are general and powerful factors.

Aqueous vapor is the great regulator of temperature, as it is less permeable than dry air to the waves of energy from the sun and still less so to those that radiate from the earth. Its influence in this direction is very important on the Isthmus of Panama because there is only a narrow strip of land between two great oceans, and consequently the relative humidity is always very high. By combining high temperatures with this high humidity there results an excessive absolute amount of moisture in the atmosphere.

In regard to the general motions of the air, it is well known that in consequence of the high temperature in the equatorial regions the air ascends; in consequence of this we should have constantly in the lower atmosphere north winds from the north, and south winds from the south, seeking to fill up the vacuum; but on account of the rotation of the earth from west to east, these directions become northeast and southwest. Nevertheless, there are circumstances, as we shall see further on, which modify this general law on the Isthmus of Panama. Thus, the observations made daily at Colon, during the year 1881, at 6 a. m., 1 p. m. and 9 p. m. (fig. 1), show 55 per cent of winds from northeast and

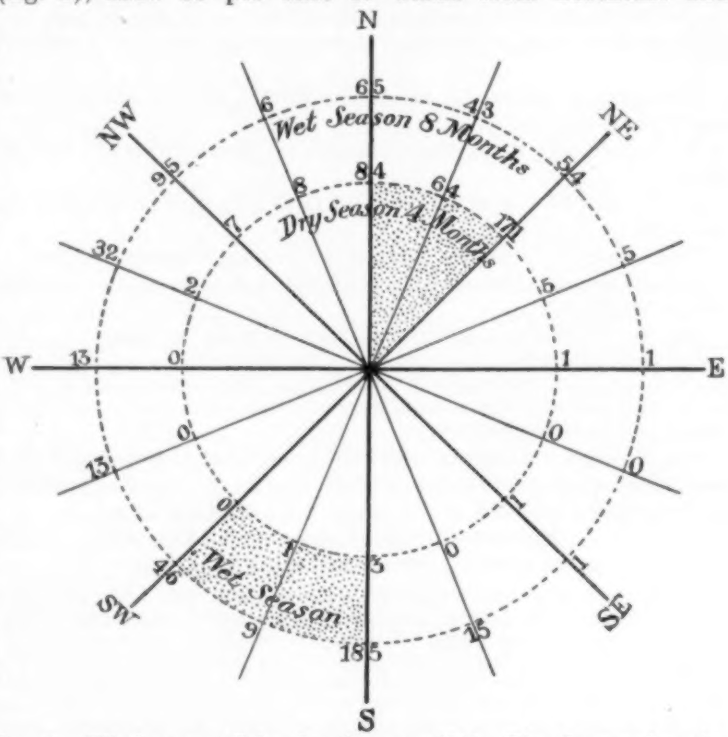


FIG. 1.—Wind rose at Colon for the year 1882. The figures give the total number of times each wind is recorded during the dry and wet seasons, respectively, at the 3 hours of daily observation. During the dry season 91 per cent of the recorded winds are from north and northeast. During the wet season 33 per cent of the recorded winds are from south and southeast.

northwest; 35 per cent between southeast and southwest, and 10 per cent from all other directions, including 1 per cent of calm. Nevertheless these percentages become, during the dry season (January, February, March, and April), 95 per cent from northeast and northwest, 91 per cent between northeast and north, 2 per cent southeast and southwest, and 3 per cent from all other directions, respectively: during the rainy season 36 per cent from the northeast and northwest; 91 per cent from southeast and southwest, of which 33 per cent between southwest and south, and 13 per cent from all other directions. That is to say, at Colon north winds prevailed during the dry season, but south winds were strongest during the rainy season; thus, these winds follow the sun as it carries northward the axis of the ascending layer of air.

In order to elucidate these facts one must remember that the geographic equator does not coincide with the thermal equator, which is the term applied to the curve that connects the points on all meridians where the annual maximum temperature is found (generally from 26° to 30° Centigrade). This thermal equator passes very near to the Isthmus of Panama, but a little to the south, on account of the great ocean current which carries thither the equatorial waters of the Atlantic, and consequently increases the temperature of the whole of Central America, commencing with the Isthmus. This is not to say, however, that the temperature there is ever very high, as we shall see later on. In a great measure, so far as concerns temperature, this ocean current neutralizes the effect of 9° of north latitude.

The axis of the ascending layer of air moves toward the north and retrogrades toward the south with the sun, oscillating in the course of a year, day by day, symmetrically across the thermal equator. This layer varies in thickness, from one place to another, according to the diverse local conditions, such as the configuration of the land, the dura-

[1] The original text of General Abbot's paper has, with his permission, been slightly modified by the Editor, so as to restrict this paper to the presentation of the climate of the Isthmus of Panama. The original data in metric measures has been compared as far as possible with published data, and has been converted into English measures by Mr. A. J. Henry, Chief of Division, who has also added an appendix containing figures not accessible to General Abbot.

tion and force of the prevailing winds, etc., but in general it is less than the distance between the extreme positions of the axis of the ascending layer.

On the whole, it follows from the above that the Isthmus of Panama is south of this entire layer for several days about the time of the summer solstice, and to the north of it for a greater number of days toward the time of the winter solstice, that is to say, that the ascending layer of warm air covers the Isthmus from the beginning of May to the end of June, and from the end of July to the beginning of December. This explains the winds observed at Colon, and many other facts concerning the climate of the region.

To sum up, the Isthmus of Panama is very near to the thermal equator, where the heat of the sun from one day to another, during the year, varies extremely little, and where it is conserved, so to speak, by a thick covering of aqueous vapor which is but slightly permeable during the day and still less so during the night. Thus, the temperature, which is determined in general by the difference between the heat received from the sun and that lost by radiation, should here have its maximum uniformity, either from day to night or from one season of the year to another.

In regard to precipitation, there are two well-marked seasons, the dry season, including the months of January, February, March, and April, and the rainy season comprising the remainder of the year. This latter season generally suffers an interruption of several days, after the summer solstice, when the rains diminish. Then the ascending layer is entirely to the north of the Isthmus.

Temperature.—The first Panama Canal Company made daily observations at Colon, Gamboa, and Naos, during the six years from 1882 to 1887, with maximum and minimum thermometers. The absolute maxima and minima for each month are found in the following tables. The means of these two temperatures have also been added; these, as will be seen below from the observations made by a self-registering thermometer, represent values which do not differ greatly on the Isthmus from the true means deduced from observations made every hour.

TABLE 1.—COLON.

Absolute maximum temperatures.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1882	85.3	87.1	84.9	87.8	88.7	88.5	88.2	89.6	91.8	92.1	88.9	89.2	88.5
1883	88.9	87.8	88.2	89.2	89.6	89.6	89.2	89.2	89.6	88.9	89.2	86.0	88.7
1884	86.4	85.6	86.4	87.8	89.6	89.6	90.7	91.4	90.5	91.2	95.9	92.1	89.8
1885	90.3	90.7	90.7	89.2	92.1	90.7	90.3	91.4	92.8	94.3	......	98.2	91.9
1886	98.2	92.8	98.2	96.8	93.9	93.9	93.2	93.9	93.9	96.1	95.7	94.6	95.2
1887	96.8	93.2	91.4	92.1	93.2	92.3	91.8	91.4	90.7	89.2	87.4	89.6	91.6
Means .	90.9	89.6	90.0	90.5	91.2	90.9	90.5	91.2	91.6	91.9	91.4	91.6	90.9

Absolute minimum temperatures.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1882	71.6	69.1	70.2	68.0	68.7	69.4	68.7	63.1	66.2	66.6	66.2	66.6	67.8
1883	68.0	70.5	64.4	65.5	69.4	68.0	68.4	66.2	69.8	68.4	63.7	66.9	67.5
1884	65.8	67.6	64.4	66.2	64.4	65.8	67.6	59.4	57.6	76.3	70.7	66.2	66.0
1885	71.2	66.9	72.7	70.2	72.0	70.5	71.6	70.2	70.5	71.2	71.2	70.2	70.7
1886	65.8	71.6	67.1	71.6	69.1	70.5	69.4	69.4	68.7	69.1	67.3	65.8	68.7
1887	67.6	69.4	66.6	69.1	68.0	70.3	70.5	73.0	74.5	72.3	73.8	73.4	70.7
Means .	68.4	69.3	68.7	68.4	68.5	69.1	69.3	66.9	69.4	70.5	68.7	70.0	68.7

*Mean temperatures, 1882–1887.**

....	79.5	79.5	79.3	79.5	79.9	79.9	79.9	79.2	80.6	81.3	80.1	79.9	79.9

Departures of the monthly means from the annual.

....	−0.4	−0.4	−0.6	−0.4	0.0	0.0	0.0	−0.7	+0.7	+1.4	+0.2	0.0	.....

*Mean absolute maximum + mean absolute minimum ÷ 2.

TABLE 2.—GAMBOA.

Absolute maximum temperatures.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1882	......	......	92.5	91.8	97.7	98.6	88.7	94.1	96.8	95.0	95.0	95.0	.....
1883	......	......	......	......	......	......	......	......	......	......	......	......	.....
1884	88.5	87.8	88.9	90.3	90.3	93.7	90.7	90.3	91.0	91.0	91.0	89.2	90.3
1885	88.2	88.9	90.3	94.3	97.5	95.4	91.4	88.9	93.6	93.9	92.1	91.0	92.1
1886	92.8	90.0	92.5	97.2	95.4	91.8	94.6	92.3	95.7	93.2	92.5	93.6	93.4
1887	91.4	90.0	92.8	91.8	96.4	93.6	93.0	91.4	91.8	93.9	93.2	91.8	92.3
Means .	90.3	89.6	90.7	93.0	95.5	97.5	91.8	91.4	94.3	93.4	92.8	91.4	92.5

Absolute minimum temperatures.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1882	......	......	62.6	53.6	63.0	59.0	71.6	66.2	66.2	66.6	64.4	......	.....
1883	......	......	......	......	......	......	......	......	......	......	......	......	.....
1884	60.4	59.0	58.6	61.2	65.8	66.6	68.0	65.8	66.9	65.8	66.2	59.0	63.7
1885	60.4	59.7	61.2	61.5	65.1	68.4	68.4	69.8	68.0	68.0	68.4	67.6	65.5
1886	58.6	60.4	61.5	65.5	68.0	68.4	66.9	68.7	67.6	60.8	67.6	63.0	64.8
1887	62.2	58.3	57.2	61.2	63.8	68.5	67.6	70.9	71.2	70.2	72.0	71.2	66.2
Means .	60.4	59.4	60.3	60.6	65.1	66.2	68.5	68.4	68.0	66.2	67.6	65.3	64.8

*Mean temperatures, 1882–1887.**

....	75.4	74.5	75.6	76.8	80.2	81.9	80.2	79.9	81.0	79.9	80.2	78.4	78.6

Departures of the monthly means from the annual.

....	−3.2	−4.1	−3.0	−1.8	+1.6	+3.3	+1.6	+1.3	+2.4	+1.3	+1.6	−0.2	.....

*Mean absolute maximum + mean absolute minimum ÷ 2.

TABLE 3.—NAOS.

Absolute maximum temperatures.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1882	91.0	89.6	89.6	92.3	94.6	94.1	91.4	91.8	89.6	90.5	89.2	91.4	91.2
1883	90.7	89.6	92.8	95.4	96.1	.....	93.6	93.2	93.2	93.2	90.3	89.2	.....
1884	91.4	91.4	91.0	92.8	92.8	94.6	96.1	95.7	95.7	91.4	93.9	91.4	93.2
1885	87.8	90.3	92.1	95.4	95.7	97.9	98.2	96.4	96.4	94.3	92.8	95.7	94.5
1886	93.6	92.8	96.4	97.5	96.1	97.2	97.2	95.5	95.4	......	91.4	91.4	.....
1887	94.3	91.8	90.3	95.0	93.6	97.5	97.7	89.6	90.0	86.7	85.3	87.4	91.6
Means .	91.4	90.9	92.1	94.6	94.8	96.3	95.7	93.7	93.4	91.2	90.5	91.0	93.0

Absolute minimum temperatures.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1882	69.8	68.4	68.0	68.0	67.1	71.6	71.6	72.3	73.4	72.0	68.0	71.6	70.2
1883	69.8	67.3	68.0	66.2	71.6	72.0	71.6	69.8	69.8	71.6	68.0	69.1	69.6
1884 .. .	66.2	66.2	65.8	69.8	69.8	72.0	69.8	71.6	69.8	69.8	69.8	66.2	68.9
1885	68.0	65.8	66.9	70.5	71.6	70.5	69.4	68.4	69.4	70.5	70.5	68.4	69.1
1886	66.6	69.1	67.3	71.2	70.2	70.2	69.4	69.4	69.4	......	70.2	69.8	.....
1887	69.8	66.6	64.4	67.3	68.0	70.3	69.3	74.8	75.9	74.5	73.4	73.4	70.9
Means .	68.4	67.3	66.7	68.9	69.6	71.6	70.2	71.1	71.2	71.6	70.0	69.4	69.6

*Mean temperatures, 1882–1887.**

....	79.9	79.2	79.3	81.7	82.2	83.8	82.9	82.4	82.4	81.3	80.2	80.2	81.3

Departures of the monthly means from the annual.

....	−1.4	−2.1	−2.0	+0.4	+0.9	+2.5	+1.6	+1.1	+1.1	0.0	−1.1	−1.1	.....

*Mean absolute maximum + mean absolute minimum ÷ 2.

TABLE 4.—COLON.

Months.	Mean temperature.	Months.	Mean temperature.	Months.	Mean temperature.
January	79.7	May.............	80.6	September	79.2
February	79.2	June	80.2	October	78.0
March	80.1	July	80.4	November	78.6
April	81.1	August	79.3	December	79.7

The first Panama Canal Company also made daily observations at Colon during the year 1881, at 6 a. m., 1 p. m., and 9 p. m., for which place the monthly means are given below.

The annual mean was 79.7°. The absolute maximum, observed May 22, was 94.1°. The absolute minima, observed March 22 and 23, and September 29, were 67.8°.

In order to ascertain the diurnal variation M. Royer has recently made observations at Panama with a self-registering thermometer during nine months, five of which were in the rainy season and four in the dry season, and also at the Haut Chagres,[1] on the coast, during April. The results of these observations are as follows: The lowest temperature was 71.6°, on March 13, at 6 a. m., and March 15 at 6 a. m. and 6 p. m. The highest temperature, 89.8°, occurred May 13, at 4 p. m. Thus the extreme range was only 18.2°.

TABLE 5.—PANAMA.

Hourly mean temperature.

Hour.	Panama, 1897. October, 13 days.	Panama, 1897. November, 19 days.	Panama, 1897. December, 19 days.	Panama, 1898. January, 21 days.	Panama, 1898. February, 13 days.	Panama, 1898. March, 27 days.	Panama, 1898. April, 10 days.	Panama, 1898. May, 24 days.	Panama, 1898. June, 19 days.	Upper Chagres, 15 days, April, 1898.
Midnight	79.0	78.4	78.1	77.5	76.6	77.7	79.5	79.3	78.4	76.1
2 a. m.	78.6	78.1	77.9	77.0	75.9	76.8	78.1	78.8	77.9	75.0
4 a. m.	78.3	77.7	77.5	76.3	75.0	76.1	77.5	78.3	77.4	74.1
6 a. m.	77.9	77.4	77.2	76.1	74.5	75.4	77.4	77.9	77.0	73.6
7 a. m.	77.9	77.2	77.0	75.9	74.3	75.2	77.4	78.3	77.4	73.8
8 a. m.	78.1	77.4	77.0	76.1	74.8	75.9	78.8	79.5	78.6	74.8
10 a. m.	80.1	78.6	77.7	79.2	80.2	80.1	83.3	82.8	81.9	79.2
Noon	81.1	79.9	79.2	81.7	82.6	82.9	84.6	83.5	82.9	82.1
1 p. m.	81.9	80.1	79.5	......	......	......	......	83.5	82.9	84.4
2 p. m.	81.5	80.1	79.9	82.9	83.8	83.9	84.9	83.5	83.1	84.7
3 p. m.	81.3	80.2	79.9	83.3	85.3	84.6	85.3	83.1	82.9	84.7
4 p. m.	81.1	80.2	79.9	83.1	85.5	85.1	85.1	82.8	82.6	84.4
5 p. m.	80.6	80.1	79.7	82.4	84.7	85.3	84.2	82.4	81.9	84.2
6 p. m.	80.2	79.7	79.5	81.7	83.5	84.4	83.3	81.9	81.3	81.9
8 p. m.	79.9	79.3	78.8	79.5	80.1	81.3	81.1	80.6	80.1	79.3
10 p. m.	79.5	78.8	78.4	78.4	77.9	79.3	79.7	79.9	79.3	77.7
Mean of the twelve even hours only	79.5	78.8	78.4	79.1	79.2	79.9	81.1	80.7	80.0	78.7

TABLE 6.—*Departures from mean temperature.*

Hour.	Panama, 1897. October, 13 days.	Panama, 1897. November, 19 days.	Panama, 1897. December, 19 days.	Panama, 1898. January, 21 days.	Panama, 1898. February, 13 days.	Panama, 1898. March, 27 days.	Panama, 1898. April, 10 days.	Panama, 1898. May, 24 days.	Panama, 1898. June, 19 days.	Upper Chagres, 15 days, April, 1898.	Means at Panama. Dry season.	Means at Panama. Wet season.
Midnight	+0.5	+0.4	+0.3	+1.6	+2.6	+2.2	+1.6	+1.4	+1.6	+2.6	+1.98	+0.86
2 a. m.	+0.9	+0.7	+0.5	+2.1	+3.3	+3.1	+3.0	+1.9	+2.1	+3.7	+2.85	+1.26
4 a. m.	+1 2	+1.1	+0.9	+2.8	+4.2	+3.8	+3.6	+2.4	+2.6	+4.6	+3.60	+1.69
6 a. m.	+1.6	+1.4	+1.2	+3.0	+4.7	+4.5	+3.7	+2.8	+3.0	+5.1	+3.98	+2.05
7 a. m.	+1.6	+1.6	+1.4	+3.2	+4.9	+4.7	+3.7	+2.4	+2.6	+4.9	+4.12	+1.98
8 a. m.	+1.4	+1.4	+1.4	+3.0	+4.4	+4.0	+2.3	+1.2	+1.4	+3.9	+3.42	+1.40
10 a. m.	−0.6	+0.2	+0.7	−0.1	−1.0	−0.2	−2.2	−2.1	−1.9	−0.5	−0.32	−0.68
Noon	−1.6	−1.1	−0.8	−2.6	−3.4	−3.0	−3.5	−2.8	−2.9	−4.4	−3.10	−1.80
1 p. m.	−2.4	−1.3	−1.1	......	......	......	......	−2.8	−2.9	−5.7	......	−2.05
2 p. m.	−2.0	−1.3	−1.5	−3.8	−4.6	−4.0	−3.8	−2.8	−3.1	−6.0	−4.05	−2.09
3 p. m.	−1.8	−1.4	−1.5	−4.2	−6.1	−4.7	−4.2	−2.4	−2.9	−6.0	−4.77	−1.98
4 p. m.	−1.6	−1.4	−1.5	−4.0	−6.3	−5.2	−4.0	−2.1	−2.6	−5.7	−4.86	−1.80
5 p. m.	−1.1	−1.3	−1.3	−3.3	−5.5	−5.4	−3.1	−1.7	−1.9	−5.5	−4.35	−1.40
6 p. m.	−0.7	−0.9	−1.1	−2.6	−4.3	−4.5	−2.2	−1.2	−1.3	−3.2	−3.38	−1.01
8 p. m.	−0.4	−0.5	−0.4	−0.4	−0.9	−1.4	0.0	+0.1	−0.1	−0.6	−0.68	−0.20
10 p. m.	0.0	0.0	0.0	+0.7	+1.3	+0.6	+1.4	+0.8	+0.7	+1.0	+0.90	+0.33

These results, like those made for the first Panama Canal Company, given above, show the extraordinary uniformity of the mean monthly temperature, as also of that from day to day. Nevertheless a characteristic difference in the temperature from one hour to another during the rainy and dry seasons must be noted. In the former the more numerous clouds and the excess of relative humidity (which latter was observed at Colon in 1881 to be 86 per cent during the rainy season and 77 per cent during the dry season), obstruct the heat of the sun, and especially the radiation from the earth, and this causes the temperature to be not much higher during the day than during the night. On the other hand, during the dry season the sky is clearer, the relative humidity less, and the temperature rises during the day and falls at night, but preserves always the same daily mean. The following figures taken from the last table will show this important difference in the two seasons by giving the values above and below the means for each month, and for the two seasons, respectively. The signs are so applied as to enable one to pass from actual observations to the monthly mean; i. e., mean — observed = departure; or, mean = observed + departure.

The hourly curves, fig. 2, show very distinctly the daily temperature to be expected at Panama in the rainy and in the dry seasons, as also the temperature in the interior during the dry season.

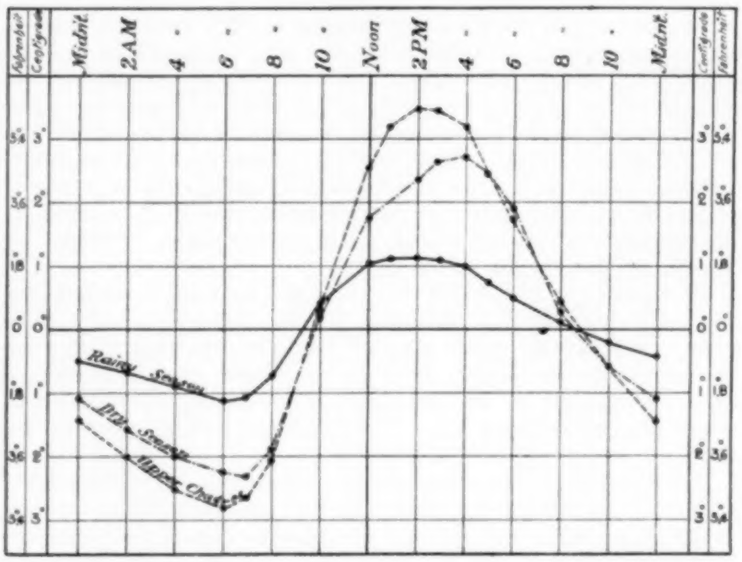


FIG. 2.—Hourly departures of mean temperatures. The zero line corresponds to 79.5° F. for the curve of rainy season; 79.8° F. for the curve of dry season; 78.7° F. for the curve of upper Chagres.

In addition to the figures given above, the first Panama Canal Company made interesting daily observations of the temperature of the water at Colon and at Naos for four years; in the following table the monthly means will be found.

TABLE 7.—*Water temperatures on the Atlantic coast at Colon.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1884	......	......	80.1	......	80.6	81.7	81.9	81.7	82.6	81.9	82.2	80.8	81.5
1885	79.5	80.8	80.4	82.0	84.0	82.9	82.0	80.1	79.9	79.9	79.9	76.8	80.7
1886	75.2	74.8	75.9	76.5	75.9	75.0	78.4	78.8	78.1	77.4	76.3	76.3	76.6
1887	73.6	71.8	71.8	73.8	74.5	82.6	83.1	86.2	87.3	86.4	85.3	85.8	80.2
1888	86.4	83.5	82.9	......	......	......	......	......	......	......	......	......	......
Means	78.7	77.7	78.2	77.4	78.8	80.6	81.4	81.7	82.0	81.4	80.9	79.9	79.9

Departures of the monthly means from the annual.

	−1.2	−2.2	−1.7	−2.5	−1.1	+0.7	+1.5	+1.8	+2.1	+1.5	+1.0	0.0	......

TABLE 8.—*Water temperatures on the Pacific coast at Naos.*

1884	......	......	72.7	......	79.0	80.8	81.0	81.0	80.8	78.8	79.3	77.9	79..
1885	71.1	67.6	66.9	72.1	77.7	77.9	77.4	76.8	77.4	77.0	76.6	76.1	74.5
1886	71.6	67.8	68.0	75.6	75.7	75.4	75.2	74.5	74.8	......	......	......	73.2
1887	......	......	......	......	78.4	79.2	77.9	83.5	85.8	84.2	83.7	83.1	82.2
1888	81.0	77.0	76.8	......	......	......	......	......	......	......	......	......	......
Means	74.6	70.8	71.1	73.8	77.7	78.3	77.9	79.0	79.7	80.0	79.9	79.0	76.8

Departures of the monthly means from the annual.

	−2.2	−5.8	−5.7	−3.0	+0.9	+1.5	+1.1	+2.2	+2.9	+3.2	+3.1	+2.2	...

In the rainy season the minimum temperature occurs at 6 a. m., and the maximum at 2 p. m. The total difference be-

[1] 177 feet above sea level.

tween these two extremes does not attain 5° F.; moreover between noon and 4 p. m. there is no perceptible change in the temperature.

In the dry season this difference between the minimum at 7 a. m. and the maximum at 3:30 p. m. increases to 9° F., but the duration of the extreme heat diminishes.

At the upper Chagres, in April, there occurs a difference of 11° between the minimum temperature at 6 a. m. and the maximum at 2:30 p. m. It appears that between 10 a. m. and 5 p. m. the heat is greater than at Panama, while on the other hand, between 11 p. m. and 8 a. m. it is less.

Finally, these characteristic variations, peculiar to seasons and places, are lost in the mean values, which are, at Panama, for the rainy season, 79.5° F., but for the dry season 80.5° F. These temperatures, which agree well with the observations of the first canal company, should not frighten one. Perhaps it will be objected that all these results relate only to thermometers that are protected from the direct rays of the sun, and have little to do with those experienced by anyone exposed out of doors without any shelter whatever. But there is nothing inaccurate in this appreciation of the climate of Panama if these figures be compared with those obtained by similar observations in other southern countries.

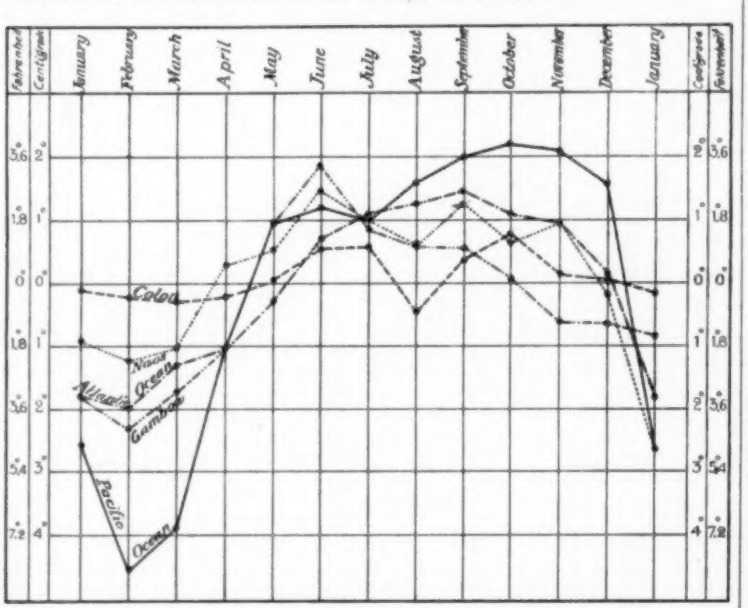


FIG. 3.—Monthly departures of mean temperatures. The zero line or normal temperature corresponds to 79.3° F. for the Atlantic Ocean; 76.1° F. for the Pacific Ocean; 79.8° F. for Colon; 81.3° F. for Naos; 78.6° F. Gamboa.

In the curves, fig. 3, where the mean monthly temperature of the air is also given, one may perceive the influence of the great marine current which carries the equatorial waters of the Atlantic to the Isthmus, as well as the action of the sun passing annually north and south of the zenith. The temperature of the Atlantic is generally higher than that of the Pacific by a maximum difference of about 9°, when the sun, in February, approaches the equinoctial line and the two seas are, respectively, colder than at any other season of the year. The minimum difference of 1.1°, in round numbers occurs after the sun has again passed that line in September, and leaves the air warmer than at any other season. It may also be noted that the mean annual temperature of the ocean at Colon (79.3°) is nearly the same as that of the air (79.9°), but that at Naos it is 5° colder (76.1° and 81.3°).

To summarize: The observations made at the Isthmus show that it is not the extreme temperatures that are to be feared. These temperatures are more favorable (under the reserve above-mentioned) than some experienced from time to time in the United States, even at the north. The complete absence of frost and the great uniformity of climate afford valuable advantages. In tropical regions it is not the excessively high temperatures which increase the difficulties of out-door labor and construction, but those which remain permanently high and are accompanied by great humidity of the air and heavy rainfall, which latter will be considered later.

Barometric pressures.—Observations made during the year 1881 at Colon at 6 a. m., 1 p. m., and 9 p. m., show a very uniform pressure. The monthly means fell from a maximum of 29.941 in April to a minimum of 29.831 in November, the annual mean being 29.886. The absolute maximum of 30.016 occurred February 26 at 1 p. m., and the absolute minimum of 29.705, November 18 at 1 p. m., which give an extreme difference of 0.311. The pressure during the rainy season is a little lower than that during the dry season.

M. Royer has just added to our knowledge in regard to the barometric pressures by giving us the original records of the observations made during three months at Panama with his self-registering barometer. These data show the same marked regularity near the Pacific coast as at Colon, i. e., an extreme variation for the three months of 0.240, of which 0.094 was the normal hourly variation. The following are the monthly results:

TABLE 9.—*Barometric pressures at Panama.*

Months.	No. of days.	Monthly means.	Maxima.	Dates.	Minima.	Dates.	Extreme variations.
		Inches.	*Inches.*		*Inches.*		*Inches.*
Nov., 1897	27	29.986	30.115	3d, 10 a. m.	29.882	19th, 20th, 22d, 3 p. m.	0.23
Dec., 1897	31	29.997	30.095	6th, 10 a. m.	29.882	12th, 3 p. m.	0.21
Jan., 1898	23	29.995	30.123	3d, 9 a. m.	29.906	18th, 3 p. m.	0.22
Means	....	29.993	30.111	....	29.890	....	0.22

The curves showing the hourly variations are equally regular and accordant. The figures in fig. 4 and in the following table, No. 10, give the values above and below the mean for each month and for three months, respectively. The signs are those needed to reduce actual observations to the monthly means:

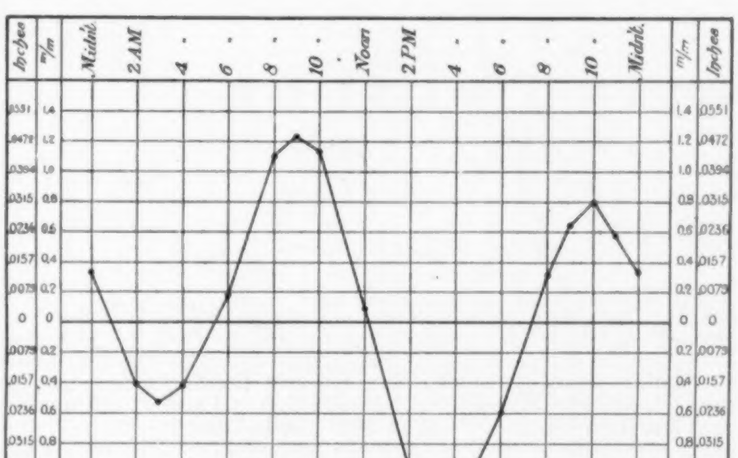


FIG. 4.—Hourly departures of mean barometric pressures.

These data are interesting, verifying as they do the well-known fact that the canal has ports, both on the Atlantic and Pacific coasts, that are quite free from the storms which accompany important variations in barometric pressure. Here

ships will not be delayed on account of the winds[1]. Similarly, in passing through the canal, particularly during the rainy season, the winds in the interior will often be calm or weak and will not be a source of trouble.

TABLE 10.—*Hourly departures from the mean barometric pressure.*

Hours.	November, 1897.	December, 1897.	January, 1898.	Mean.	Remarks.
	Inch.	*Inch.*	*Inch.*	*Inch.*	
Midnight	−.016	−.012	−.012	−.013	
2 a. m.	+.012	+.020	+.016	+.016	
3 a. m.	+.020	+.024	+.020	+.021	Minimum.
4 a. m.	+.016	+.020	+.016	+.017	
6 a. m.	−.008	−.004	−.008	−.007	
8 a. m.	−.043	−.043	−.043	−.043	
9 a. m.	−.055	−.043	−.047	−.048	Maximum.
10 a. m.	−.051	−.039	−.043	−.044	
Noon	+.004	.000	−.004	.000	
2 p. m.	+.039	+.035	+.039	+.038	
3 p. m.	+.051	+.047	+.043	+.047	Minimum.
4 p. m.	+.051	+.043	+.043	+.046	
5 p. m.	+.043	+.035	+.032	+.037	
6 p. m.	+.028	+.020	+.024	+.024	
8 p. m.	−.008	−.020	−.008	−.012	
9 p. m.	−.024	−.032	−.020	−.025	
10 p. m.	−.028	−.028	−.039	−.032	Maximum.
11 p. m.	−.024	−.024	−.020	−.023	

PRECIPITATION.

The archives of the present canal company contain much data which throw light upon the question, which rainfall is summarized in the following tables. These numbers sometimes differ from those published elsewhere, but having been copied from the original manuscript record of the Panama Canal Company are believed to be authoritative and correct.[2]

TABLE 11.—*Precipitation at Colon.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1881	......	......	1.08	2.52	10.04	15.28	12.24	6.46	6.30	12.91	22.13	10.35	......
1882	1.65	1.10	1.69	1.73	13.23	18.90	19.10	13.94	10.63	14.96	22.09	5.08	124.10
1883	1.85	0.47	0.55	1.77	11.85	10.08	13.39	25.43	11.14	16.77	11.10	10.94	115.34
1884	3.39	0.39	0.39	4.33	10.16	10.32	15.59	13.27	9.37	8.66	7.05	3.62	86.54
1885	0.87	0.59	0.55	1.34	7.91	16.61	22.99	20.32	17.44	7.99	24.17	25.51	146.29
1886	2.13	5.00	9.17	1.58	13.15	16.38	11.10	12.20	7.52	14.33	21.89	22.72	137.17
1887	2.01	0.67	0.47	10.63	10.28	16.50	17.05	16.89	15.63	19.61	31.81	13.33	154.90
1888	0.63	1.58	1.26	......	......	......	......	......	......	......	......	......	......
1889	......	......	......	......	......	......	......	......	......	......	......	......	......
1890	7.24	1.02	2.01	2.99	9.76	17.24	10.24	20.51	22.99	21.77	19.49	19.06	154.32
1891	2.52	0.51	1.50	0.51	23.00	7.99	14.02	15.98	17.48	17.48	19.49	4.25	124.73
1892	0.98	2.01	3.98	5.00	18.08	16.97	21.77	15.98	16.26	6.69	26.30	11.30	145.27
1893	1.73	3.82	1.81	8.07	6.58	12.32	11.50	15.12	9.92	12.28	17.80	30.94	131.89
1894	5.35	1.65	0.35	2.16	9.85	12.24	19.10	23.03	18.78	12.40	23.66	25.12	153.69
1895	3.86	1.89	2.09	21.73	16.77	9.25	17.09	14.13	12.09	16.46	20.47	15.71	151.54
1896	4.02	1.30	2.01	9.02	16.46	8.50	13.58	15.51	12.84	13.98	15.63	18.66	131.51
1897	3.42	0.04	0.28	3.74	16.34	18.82	14.06	17.24	17.20	5.83	22.16	18.90	138.03
1898	5.04	0.35	1.58	4.72	12.83	16.38	21.89	10.91	10.24	11.38	12.28	7.95	115.51

TABLE 12.—*Precipitation at Bohio.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1896	......	......	......	......	15.63	8.54	5.55	......	25.51	13.35	17.05	......	......
1897	......	......	3.07	8.11	18.54	14.10	15.83	25.20	17.48	26.02	19.57	22.05	......
1898	12.36	1.26	......	......	14.61	19.76	......	......	......	28.23	21.81	6.38	......

[1] In this report it may be observed that the first canal company made daily observations of the tides at Colon and at Naos during sixty months, from 1882 to 1887. The most marked movements in each of these months gave for Colon a mean amplitude of 1.434 feet, with a maximum amplitude of 2.07 feet in August, 1883, and a minimum amplitude of 0.62 feet in March, 1886. At Naos these amplitudes were: mean 18.750; maximum 20.93 in October, 1883; and minimum 16.40 feet in December, 1882, respectively. At Colon only thirteen tides exceeded 1.64 feet, and at Naos only fourteen exceeded 19.68 feet during these sixty months.

[2] The conversions here given follow General Abbot's data and occasionally differ from conversions based on the figures published in the Annals of the Central Meteorological Bureau of France, owing to the omission of fractions of a millimeter and to errors in printed documents, from which the figures given in the Annals appear to have been taken. The latest manuscript corrections and additions by General Abbot have been incorporated in these tables.—ED.

TABLE 13.—*Precipitation at Gorgona.*

1896	......	......	......	....	9.02	6.81	5.16	8.98	13.35	10.94	14.37	......	......
1897	......	0.08	......	2.60	25.12	13.54	9.65	16.93	15.98	14.41	7.16	7.91	......
1898	3.42	0.20	......	......	5.04	4.37	......	......	......	7.72	9.61	3.94	......

TABLE 14.—*Precipitation at Gamboa.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1881	......	......	......	......	......	10.63	12.40	9.17	10.39	11.06	12.95	4.76	......
1882	......	......	0.51	1.50	15.47	6.26	10.12	9.88	11.81	8.15	11.81	1.38*	......
1883	......	......	......	2.60	9.68	11.02	6.54	15.94	4.13	10.04	7.01	6.30	......
1884	......	0.71	0.28	6.46	6.18	13.35	9.62	16.50	10.55	22.36	6.18	2.20	......
1885	0.20	0.20	0.00	1.38	11.06	10.35	9.06	15.51	16.10	9.33	13.23	11.06	97.48
1886	0.55	1.06	0.71	2.76	15.71	10.55	11.69	16.38	9.13	13.62	16.10	4.61	102.87
1887	2.20	0.08	0.28	6.85	11.02	19.45	14.02	19.17	11.50	14.88	24.06	16.28	136.19
1888	0.12	0.63	0.85	1.26	20.47	11.93	3.27	10.24	12.28	9.57	16.18	16.34	102.64
1889	1.97	4.53	1.42	0.00	4.37	9.10	7.28	10.51	11.42	13.07	8.70	3.35	75.72
1890	4.06	0.35	2.36	3.03	13.27	11.65	10.43	15.35	8.90	21.41	9.92	4.29	105.03
1891	0.63	0.00	0.35	2.13	7.48	9.29	6.06	8.50	10.47	15.71	10.67	6.88	77.67
1892	1.10	0.67	2.56	4.72	16.81	8.54	13.98	14.33	13.74	11.10	10.24	6.58	104.37
1893	0.67	1.06	0.71	7.44	11.89	10.71	15.87	7.95	10.24	16.50	13.90	20.87	117.81
1894	1.46	0.16	0.04	1.34	10.94	8.78	10.08	8.42	15.16	15.28	10.67	8.27	90.60
1895	......	......	......	......	......	......	......	......	......	......	......	......	......
1896	......	......	......	......	3.35	3.31	5.79	......	......	......	......	......	......
1897	......	0.20	0.28	3.23	17.44	12.64	9.10	17.20	18.82	12.80	5.91	8.62	......
1898	2.76	0.12	......	......	5.32	4.65	......	......	......	8.70	14.57	2.40	......

* The figures 1.38 for December, 1882 have been added to this table for Gamboa by copying from the Annals of the Central Meteorological Bureau for 1882, Part IV, p. 118.—ED.

TABLE 15.—*Precipitation at Bas Obispo.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1884	1.10	0.35	0.35	2.16	3.86	11.97	8.46	10.51	13.98	12.40	6.93	2.64	74.71
1885	0.24	0.12	0.00	1.14	7.36	8.74	6.34	12.84	12.87	8.94	11.10	11.50	81.23
1886	0.83	0.87	0.87	1.69	17.44	12.91	9.02	8.27	10.20	9.37	15.63	3.90	91.00
1887	2.28	0.00	0.12	3.19	10.16	15.43	10.87	8.03	10.98	7.36	14.06	15.79	98.27
1888	0.16	0.51	0.32	0.91	11.58	11.93	1.93	7.76	7.13	3.82	10.59	10.08	66.72
1889	0.79	0.32	1.10	6.50	4.57	9.84	6.42	8.98	13.46	13.23	8.54	3.78	77.53
1890	4.53	0.12	2.56	2.56	13.07	14.96	9.88	12.16	13.03	4.80	6.54	7.95	92.16
1891	6.10	0.00	0.35	2.16	5.83	11.54	6.10	7.76	12.32	14.49	8.35	8.72	83.82
1892	0.79	0.63	2.56	4.76	15.16	10.51	13.10	11.93	17.36	10.28	11.02	6.97	105.07
1893	0.55	1.34	0.71	3.19	19.57	10.75	14.37	9.57	10.63	19.84	13.35	19.13	123.00
1894	1.97	0.32	0.20	1.38	11.89	10.00	10.59	......	......	......	......	......	......

TABLE 16.—*Precipitation at Emporador.*

1888	......	......	......	1.26	11.50	10.32	......	10.71	5.47	......	......	5.04	......

TABLE 17.—*Precipitation at Culebra.*

1884	0.20	0.04	0.67	3.78	......	......	10.24	13.62	8.70	10.12	11.18	1.46	......
1885	0.28	0.00	0.00	1.61	15.39	......	4.29	5.35	11.38	10.63	7.20	34.57	......
1886	0.43	0.55	0.16	1.18	13.78	12.64	14.33	8.19	7.36	20.63	14.29	5.43	98.97
1887	3.15	0.00	0.04	3.50	7.91	9.96	6.10	8.74	7.64	9.65	12.13	7.95	76.77
1888	0.24	0.04	0.51	0.35	11.42	7.99	2.91	6.54	11.26	5.75	9.53	7.72	64.25
1894	......	......	......	......	......	......	......	......	12.13	13.50	13.23	10.00	......
1895	......	0.75	......	......	......	......	......	......	......	......	......	......	......

TABLE 18.—*Precipitation at Panama.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1879	0.04	2.52	5.71	5.55	10.28	6.46	7.91	7.24	9.02	9.80	19.21	0.98	84.73
1880	1.89	0.12	0.16	1.61	4.45	5.00	9.88	11.46	7.91	11.81	6.46	5.51	66.26
1881	0.16	0.16	0.35	3.23	10.35	13.78	7.20	4.49	8.94	9.08	9.72	2.48	70.55
1882	0.00	0.12	0.00	0.98	5.24	6.18	5.35	4.05	4.05	6.69	10.91	2.01	45.60

TABLE 19.—*Precipitation at La Boca.*

1881	......	......	......	......	10.94	11.65	7.16	......	......	......	......	......	......
1894	......	......	......	......	......	7.48	12.72	6.42	7.32	10.51	6.73	8.27	......
1895	1.38	0.08	......	......	......	......	......	......	......	......	......	......	......

TABLE 20—*Precipitation at Naos.*

1881	......	......	......	......	......	......	......	......	......	......	7.48	2.87	......
1882	0.00	0.04	0.04	0.94	4.53	5.08	1.61	1.14	1.14	2.72	5.04	2.84	25.12
1883	0.59	0.00	0.00	1.93	4.45	2.56	5.47	5.51	4.64	4.25	7.24	3.11	39.76
1884	2.01	0.04	0.00	0.94	4.84	4.17	4.65	2.99	5.71	8.31	8.62	1.34	43.62
1885	0.55	0.20	0.00	0.91	2.56	5.63	2.64	5.51	4.17	9.96	4.37	4.92	41.42
1886	0.00	0.28	1.81	1.92	5.20	6.26	9.61	5.91	20.75	6.10	4.49	3.74	66.06
1887	0.79	0.04	0.04	2.36	5.24	9.88	4.06	6.69	6.97	7.05	8.82	5.59	57.52
1888	0.08	0.00	0.04	0.28	5.55	4.88	2.01	5.71	8.58	8.11	4.02	1.30	40.55
1889	0.00	0.00	0.91	4.41	5.79	5.43	......	......	......	......	......	......	......

Finally, the results which flow from these figures can be seen at a glance in fig. 5, herewith. Remembering that the monthly means relate to the middle of the month, we see that throughout the whole Isthmus the rainy season begins immediately after May 1, but that soon the rains decrease on account of the northward advance of the layer of rising air. This diminution takes place in July in the interior of the Isthmus, but is subject to a delay of one month on the Pacific side and of two months on the Atlantic side. A second maximum in the rainfall occurs at the end of September in the interior, but at the end of October on the Pacific coast and in the middle of November on the Atlantic coast. Then comes the dry season, which, everywhere on the Isthmus, begins about the 1st of January and continues for four months, on account of the southward return movement of the ascending layer.

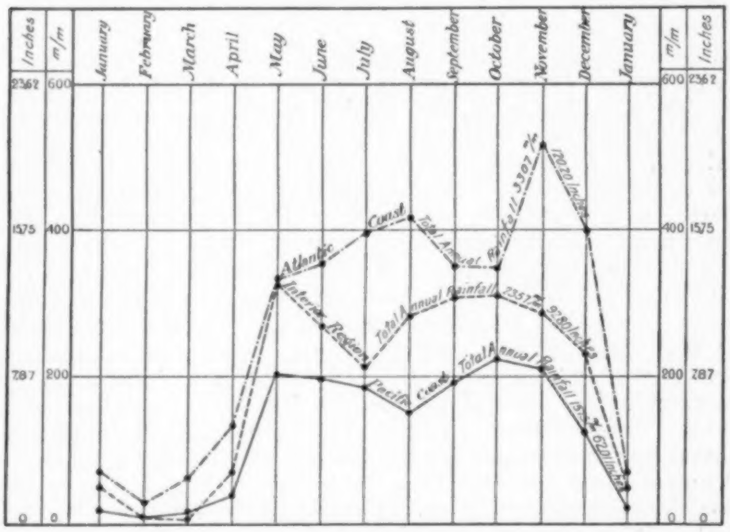


FIG. 5.—Total monthly precipitation on the Isthmus of Panama. These curves are based on the following data: For the Atlantic coast one station, Colon, for 15 years. For the Pacific coast three stations, La Boca, 1 year; Naos, 8 years; Panama, 4 years; total, 13 years. The interior of the Isthmus four stations, Gorgona, 2 years; Gamboa, 15 years; Bas Obispo, 10 years; Culebra, 5 years; total, 32 years.

These two periods of heaviest rains do not differ much from each other as to the maximum volume of water, except on the Atlantic coast, where the second period has a greater quantity of rainfall; but it must be particularly noted that the total quantity of precipitation is far from being the same everywhere. The figures are given in the following table.

TABLE 21.—*Annual precipitation, in inches.*

Section and station.	Length of record, years.	Maximum.	Minimum.	Mean.	General mean.
Atlantic coast:					
Colon	15	154.89	116.36	130.20	120.20
Interior region:					
Gorgona	2	......	......	99.77	92.80
Gamboa	15	136.58	71.65	96.54	
Bas Obispo	10	123.03	76.69	89.29	
Culebra	5	98.98	64.25	85.67	
Pacific coast:					
Panama	4	84.73	45.59	66.77	62.01
La Boca	1	......	......	73.70	
Naos	8	66.06	64.49	45.98	

These facts show that all the most difficult works of the Panama Canal, except, perhaps, the locks and the dam of Bohio, are situated in the interior or near the Pacific, where the rains are not very violent. Although the quantity of rainfall is large it is quite comparable with what is to be found in the United States near the Gulf of Mexico. Thus, the observations for many years give the following comparisons:

Station.	Number of years.	Mean precipitation.	Annual maximum.
		Inches.	*Inches.*
New Orleans, La	23	51.18	67.32
Mount Vernon Arsenal, Ala	15	66.14	106.69
Baton Rouge, La	15	59.45	116.54
Isthmus of Panama:			
Interior	32	92.91	136.61
Pacific coast	13	61.81	84.65

APPENDIX.

By A. J. HENRY, Chief of Division, Weather Bureau.

The following contains additional tables of rainfall for the Isthmus of Panama, compiled from manuscript and other records now in the archives of the Weather Bureau.

The observations at Colon, 1862 to 1874, were made by Drs. W. T. White and J. P. Kluge, surgeons of the Panama Railway Company. Those for 1893–95 were kept by O. B. Schaffer, C. E., Panama Railway.

The record for Taboga Island, 1861–66, is drawn from a report on interoceanic ship canals, page 29, published as Senate Ex. Doc. No. 75, Forty-fifth Congress, 3d Session.

It is proper to state that the officials of the Panama Railway Company have been asked to furnish a complete record of rainfall made by the officers of the Company at Panama, from the beginning of observations in 1862 to the present time.

TABLE 22.—*Precipitation at Colon.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1862	......	......	......	......	......	......	......	......	......	13.10	43.01	16.83	......
1863	1.75	2.94	0.85	......	13.09	15.82	25.76	10.34	15.54	11.22	17.59	15.21	......
1864	1.90	0.77	0.78	0.44	15.87	8.78	......	13.37	17.85	12.83	17.90	16.40	......
1865	[1.10]	1.08	0.02	3.89	9.22	16.85	9.61	18.39	8.55	9.69	22.16	6.58	107.4
1866	3.99	1.07	0.21	4.07	14.76	12.17	16.72	12.72	18.82	15.04	21.72	8.42	129.7
1867	1.56	0.80	0.48	1.20	11.88	8.85	16.08	19.82	5.85	20.50	......	......	......
1868	†1.17	2.77	2.18	0.87	7.24	18.11	20.60	12.50	16.16	13.13	21.58	3.72	120.0
1869	0.84	0.77	0.49	5.04	6.72	10.66	18.22	14.02	8.98	14.82	24.13	10.10	114.8
1870	4.30	3.33	4.95	6.46	20.95	12.48	15.60	16.35	6.74	11.21	32.42	14.85	149.6
1871	15.42	0.53	0.05	1.52	1.63	7.70	23.27	11.56	8.00	12.58	12.38	4.94	99.6
1872	3.57	0.75	0.83	1.30	21.43	22.00	19.90	19.97	16.20	30.32	19.11	13.12	168.5
1873	6.33	0.25	0.13	2.18	3.92	13.20	12.50	10.69	10.91	14.30	11.77	0.94	87.1
1874	5.33	1.34	3.94	18.02	8.92	15.87	13.62	17.28	8.22	16.65	20.62	7.89	137.7
1893*	1.73	3.86	1.81	8.05	6.65	12.34	11.44	15.10	9.92	12.28	17.78	30.94	131.90
1894	5.35	1.69	0.36	2.18	9.84	12.24	19.08	23.02	18.79	12.43	23.66	25.12	153.76
1895	3.85	1.82	2.08	22.36	16.17	9.25	17.10	14.15	12.11	16.47	......	......	......

*O. B. Schaffer, C. E., Panama Railway. See M. W. R., 1898, page 362.
†One day missing.

[Mr. C. F. Talman, Weather Bureau Observer at Colon, reports that the rainfall for Colon in 1895, as published in the MONTHLY WEATHER REVIEW, 1898, p. 352, and 1899, p. 203, differs in some cases from the records in the office of the Panama Railroad Company at Colon, which, he states, reads as follows: 1895, April, 21.96 (not 22.36); May, 18.14 (not 16.17); September, 12.10 (not 12.11). No explanation of these differences is known.—ED.]

TABLE 23.—*Precipitation at Taboga Island.*
N. 8° 48′, W. 79° 32′; altitude 10 feet.

1861	0.00	0.00	0.00	2.16	14.30	10.91	8.27	4.30	8.87	11.19	5.23	6.76	71.99
1862	......	......	......	......	......	......	......	......	......	......	......	......	......
1863	0.00	0.00	0.00	0.26	1.60	8.80	8.11	9.54	11.94	1.62	2.87	3.77	48.51
1864	0.50	0.00	0.00	0.00	3.13	4.78	2.08	5.91	3.60	11.33	2.97	11.42	45.72
1865	......	......	......	......	......	......	......	......	......	......	......	......	......
1866	......	......	......	......	......	......	......	8.74	4.90	5.16	5.12	4.30	......

SPURIOUS TORNADO PHOTOGRAPHS.

By Mr. ALFRED J. HENRY, Chief of Division.

We have watched with interest and curiosity the efforts of some manipulators of the camera to reproduce the phenomena of nature in all her varying moods. There can be no particular fault found with the enterprise of the photographer, be he amateur or professional, who sallies forth at high noon, or soon thereafter, and under the friendly shadow of an accommodating cloud makes *moonlight* views by the score. We confess, too, that we can pass into the waste

basket without hesitation the many poor attempts to fabricate the funnel cloud of a tornado. We received one such not very long ago from Mr. Connor. It was better than the average, and instead of going into the trash basket it went into a convenient drawer. Now we are glad that we kept it, for along comes a photograph kindly sent us by Mr. Gosewisch, of the tornado cloud that brought death and destruction to so many homes in Kirksville, Mo., on April 27, 1899.

We thought we had seen that tornado cloud before, and the more we looked at it the more certain we were that we had met an old friend. When we first saw it our funnel cloud was stirring up the dust and incidentally frightening the inhabitants of Waynoka, in far-off Oklahoma, and this was more than a year ago. The scene has now changed to a quiet road in Missouri across which our Oklahoma tornado cloud appears to be crossing, while a couple of artistic Rubens watch its progress in wonder and amazement. The job is well done. There is no particular fault to be found either with the conception or the execution, but it pains us to think that people will take such liberties with the business end of a tornado. Only to think, "It was taken at 100 yards!" We sincerely hope that the pioneer who "took it at 100 yards" will some day meet a real robust tornado.

For the edification of the readers of the MONTHLY WEATHER REVIEW we print the two pictures on Plate I. On the left-hand is the Waynoka picture, on the right-hand is that for Kirksville. The Waynoka tornado is mentioned at page 201 of the REVIEW for May, 1898, where it is said to have begun about 6:30 p. m., central time, about 3 miles west of Waynoka, on Tuesday, May 17. The date, May 24, given on the back of the Waynoka photograph is probably an error of one week.

It is possible that the Waynoka picture was made by superposing a tornadic funnel upon a beautiful photograph of sunset clouds and landscape. The Kirksville picture retains the funnel and clouds of the Waynoka picture, but substitutes a view of a road and its osage hedges, such as might occur in Missouri. But where did the original funnel come from? It is evidently not a photograph from nature of a genuine tornado funnel. It has every appearance of having been drawn in india ink on glass and then photographed by printing upon the landscape negative. The retouching of original negatives so as to convert a portrait from nature into a beautiful work of art is carried on in great perfection by modern artists, but any application of this art to photographs that are to be used for scientific purposes does more harm than good.

The latest turn in the history of this picture has been given by its publication in the Philadelphia Press of Sunday, June 23, 1899, where our Kirksville picture with its Missouri landscape appears as "the Waynoka tornado of May 18, 1898, at about 1,000 feet distance." This change of distance would seem to have been necessitated by the perspective distance inherent in the beautiful Missouri landscape; the change of date is possibly a misprint.

We shall doubtless see the Waynoka clouds and funnel reproduced again, at no distant date, in connection with some other dreadful disaster. The argument seems to be: "If there was a disaster, it must have been a tornado; if a tornado, it must have had a funnel; if a funnel, there must be a picture; this is a photograph, therefore it will do."

THE METEOROLOGICAL SERVICE OF CANADA.

By Prof. R. F. STUPART, Director.

The Meteorological Service of Canada is an organization maintained by the Dominion Government and is a branch of the Department of Marine and Fisheries.

The work of the Service comprises the issue of weather forecasts for the benefit of shipping, fishing, and agricultural interests, the collection of climatological data for purposes of agriculture and the information of immigrants, etc., and scientific meteorological research.

There are now in the Dominion 304 stations at which observations are taken with instruments supplied by the Government and which report to the Central Office, Toronto. They are divided as follows: 4 first order, 65 second order, 206 third order, and 89 rainfall stations.

At Banff, in the Rocky Mountains at an altitude of 1,384 meters, there is at present a station of the second order, and within the next year it is hoped that we shall be able to establish a station with self-recording instruments on the top of Rundle Mountain within a few miles of Banff at an altitude of 2,921 meters. Thirty-seven stations report by telegraph twice daily, and two stations, St. Johns, N. F., and Bermuda once daily; these two latter although not in the Dominion are maintained by the Dominion Government. Almost invariably all reports from stations between Lake Superior and Cape Breton are received in the Central Office by 8:30 a. m. and p. m. and then forwarded without delay to the United States Weather Bureau at Washington via Buffalo, N. Y., from which place some 60 United States stations are in return sent to Toronto, together with the Canadian reports from Manitoba westward to British Columbia. All reports are usually received shortly after 9:30 and the working chart is ready for the forecasting official by 9:45, and by 10 o'clock the isobars have been drawn and some of the forecasts telegraphed to their destination. The bulletin issued at night comprises a short synopsis of the weather during the past day and generally a description of the existing meteorological conditions, then a list of the highest and lowest temperatures recorded at about a dozen stations, followed by the forecasts for the various districts lying between Manitoba and the Maritime Provinces. These forecasts are for the twenty-four hours beginning at the following 8 a. m. unless it be expressly stated that they cover a longer period. That same evening the telegraph company sends the bulletin to all points where morning newspapers are published, in which it is generally printed at the head of the column of local news, and then in the morning on the opening of the various telegraph offices throughout the Dominion the first message which goes over the wires is the daily forecast, which is posted up in a conspicuous place in every telegraph office. Up to the summer of 1894 the forecast based on the 8 p. m. was practically the only one issued, but since that time a second forecast covering the current and following day has been issued at 10 a. m. This is sent to nearly all ports, both on the Great Lake and on the seaboard, and arrangements have recently been made whereby it appears in most of the afternoon newspapers published in the Dominion.

There are in the Dominion 70 stations at which cautionary and storm signals are displayed—32 on the Lakes and 38 in the Maritime Provinces. The signals used are drums and cones, the cone alone being hoisted when but a moderate gale is expected, and both drum and cone together when it is thought that the storm will be heavy. The apex of the cone downward indicates southerly and easterly directions and upward northerly and westerly.

As a means of disseminating more generally the forecasts among the farming community during the summer season, white discs, indicating "fine," "showers," or "rain," are placed each afternoon on the baggage vans of outgoing trains, being the forecasts for the next day.

Each morning some seventy-five copies of the weather chart are made by means of a duplicating machine, the mimeograph, and supplied to a few subscribers, to the Toronto newspapers, to the board of trade, and to such business people who engage to post them where they will be seen by the public.

Until the summer of 1898 forecasts were not issued for portions of the Dominion lying west of Manitoba, but arrangements were then made whereby telegraphic reports from stations near the Pacific coast, together with about 12 United States stations, furnished through the courtesy of the Chief of the Weather Bureau, are forwarded twice daily to Victoria, B. C., at which place the agent of the Meteorological Service is local forecast official, and now issues regular daily forecasts based on a weather chart nearly as complete as will be possible until telegraphic communication be established with more northern portions.

The Canadian Service fully appreciates the necessity of extending its system of meteorological stations over the northern part of the Continent, and we now have observations taken at Herschel Island, in the Arctic Sea,[1] Hay River, latitude —° —′ north, longitude —° —′ west; Fort Simpson, latitude 61° 52′ north, longitude 121° 43′ west; Fort Churchill, latitude 58° 51′ north, longitude 94° 11′ west; York Factory, latitude 57° 0′ north, longitude 92° 28 west; Moose Factory, latitude 51° 16′ north, longitude 80° 56′ west; Martins Falls, latitude 51° 30′ north, longitude 86° 30′ west; Fort Chipewyan, 58° 42′ north, 110° 10′ west; Fort Good Hope, latitude 66° 20′ north, longitude 128° 25′ west; Norway House, latitude 53° 58′ north, longitude 97° 52′ west; and at Dawson and several other points in the Yukon. Bidaily telegraphic reports are received from Barkerville, B. C., the farthest north telegraph station on the Continent, and it is probable that in the near future Dawson may be added to the list.

It may be added that the Dominion Magnetic Observatory, now situated at Agincourt, 9 miles from the Central Meteorological Office and 6 miles from any lines of electric tramway, is under the supervision of the Director of the Meteorological Service.

AN ADVANCE IN MEASURING AND PHOTOGRAPHING SOUNDS.[2]

Prof. BENJAMIN F. SHARPE, M. A.—(Dated Greenwich, N. Y., June 1, 1899.)

THE NATURE OF THE PROBLEM.

Since the passage of sound through the air consists in alternate condensations and rarefactions, a direct measurement of the intensity of sound must measure these changes in atmospheric pressure. Practically this has been very difficult to do for two reasons: first, because these pulsations follow each other so rapidly. Middle C on the piano, for instance, has 256 condensations, each followed by a rarefaction, making 512 distinct pressure maxima and minima in a single second; evidently no ordinary instrument for measuring pressure, such as the barometer, would serve in this case. But the second and greater difficulty lies in the fact that these condensations are so exceedingly minute, being indeed from a hundred thousand to a million times smaller than the pressure differences that can be read on an excellent mercurial barometer.

Consequently the energy acting upon the ear drum in case of the faintest, audible sound is of the same order of magnitude as the energy falling upon the retina from the faintest star visible to the naked eye, a star of the 6th magnitude; while the energy of a sound of maximum intensity (at this point the ear ceases to distinguish which of two tones is the louder) is about as much as that involved in the growth of a single, ordinary blade of grass in June. So in every case we are dealing with very minute quantities of energy.[1]

There are a great variety of sounds to be measured, but for convenience we may group them all into three great classes: noises, musical notes, and pure tones. Of these pure tones are the simplest, for they consist of a definite number of pulsations per second, and the pulsations follow each other at equal intervals. A tuning fork affords a good example. If it be struck gently, it produces a faint tone, if it be struck harder a louder tone is heard, but the sound does not change in character or in pitch; only the intensity of the tone changes. If we wish to change the pitch, a fork of different dimensions must be taken. Consequently there are two measurements to be made in studying even the simplest sound, viz, loudness or intensity, and pitch or frequency, the latter being the number of pulsations per second. A musical note is some combination of pure tones, whose frequencies bear a simple ratio. But the choice of the component tones, as well as their relative intensities, determines the differences in quality or timbre, such, e. g., as the difference observed between the same note produced on the flute and on the violin. A musical note, accordingly, has to be analyzed into its component tones before the note is fully determined. We might naturally suppose that a further distinction might be made based on the differences of phase arrangement possible in a note, but it is found that the ear does not appreciate these differences, though the photographic instrument herein described makes them evident to the eye. If now we add to a note a single tone whose frequency does not bear a simple ratio to the other component tones of the note, a discordant sound or noise results. And even though a particular noise contained a hundred tones and not a single simple ratio, its complete determination would involve nothing more than the determination of the frequencies and intensities of all the component tones at the given instant. Of course these components may be continually changing from moment to moment. In fact noises are hardly ever constant in either loudness or quality, and this fact, together with the very great variety of frequencies, which the component tones may have, renders it so difficult to completely determine a noise, that as yet this has never been done. But our instrument will photograph a noise as well as any other sound, and by the aid of the photograph we may determine its principal component tones, and also the intensity of the noise.

AN INSTRUMENT TO MEASURE SOUND.

We would naturally begin with the simplest case in working toward a sound-measuring instrument, and fortunately this is also the case of the greatest physical importance, since all the theoretical laws concerning the propagation of sound assume a pure tone. To test these laws, or rather to derive

[1] Latitude, 69° 25′ north; longitude, 138° 53′ west, near the mouth of the McKenzie River.—ED.

[2] The work here described was done recently by the author, Prof. B. F. Sharpe, while a Fellow in Clark University, following a suggestion made by Professor Webster. A much more detailed, technical account of the apparatus and the associated mathematical theories will be published later. This general, preliminary account has been prepared for the MONTHLY WEATHER REVIEW at the request of the Editor in the belief that the instruments and methods here given will prove serviceable in certain special meteorological investigations, since the faintest waves of pressure are recorded by the apparatus.

There are many acoustic phenomena observed in the atmosphere whose analysis, with the help of proper apparatus, ought to give us methods of determining the velocity of any movement going on in the air, the temperature of the air, the disturbances produced by warm bodies, by the explosions that attend meteors, lightning, cannonading, etc., and especially those that attend the formation of rain, hail, and snow. It is not for the ordinary Weather Bureau observer to conduct these delicate investigations; they are the special province of the mathematical physicist and laboratory expert. To the latter meteorology must look for the further building up of this branch of our science. It is likely that the study of the vagaries of the sounds from fog signals, which has been prosecuted by our Lighthouse Board without the help of Professor Sharpe's ingenious apparatus, would become more precise and satisfactory if his methods could be applied to that study. Meteorology has much to hope from the proper study of sound waves, which are, in fact, only minute waves of barometric pressure and Professor Sharpe's methods take up the subject where the ordinary barograph fails on account of its sluggishness.—ED.]

[1] Wien, Ueber die Messung der Tonstärke, Berlin. 1888, p. 47.

them experimentally, we do precisely as we would in any scientific investigation, i. e., eliminate unnecessary complications, in this case by dealing with a pure tone.

A pure tone of medium pitch may be magnified forty or fifty times by receiving it in a Helmholtz resonator. This is nothing but a hollow sphere of some hard substance like brass or glass, having a hole for the tone to enter, and a small, funnel-like projection to place in the ear. Within this resonator the condensations and rarefactions may be fifty times greater than in the open air. But any cavity magnifies, though not so much, some one tone to which it resounds. A "Mellin's Food" bottle, for instance, is a resonator to a note a trifle below middle C. When its open mouth is held near the ear and its note is sung, the bottle is heard to resound very strongly. So we have taken one step toward overcoming the twofold difficulty by magnifying the infinitesimal pressures of sound by means of a resonator, carefully constructed,[1] to resound to the tone which we propose to measure. Another step is taken by causing these magnified pressures to act upon a very sensitive plate.

Here is the same principle as that involved in the telephone and phonograph. The pulsations of the air within the resonator force the plate to vibrate in close imitation; for the thin plate is made to form a part of the walls of the resonator, by cutting out a circular hole in the resonator opposite its mouth, mounting a ring on this circle, and attaching the plate to the ring. We make this step as long as possible by so choosing the substance and dimensions of this plate,[2] that its own fundamental tone when mounted is identically that of the tone to be measured. Here again we invoke the aid of the principle of resonance, which is a very powerful and far reaching principle. In this instance we obtain no further magnification of the sound motion, but we gain this great advantage, that instead of the infinitesimal motions of invisible particles of air, we have now a measurable motion of the center of a definite plate of solid substance.

Therefore we next require some optical device for observing this motion. Prof. A. A. Michelson's form of the refractometer[3] is admirably suited to our purpose. It consists of a system of mirrors by which one beam of light is separated into two beams; these travel paths differing slightly in length, so that, when they are reunited, the interference of the waves of light produces interference bands. The arrangement of the mirrors is shown in fig. 1.

B is a metal base with horizontal surface. On this the mirrors are mounted with their reflecting planes perpendicular to the surface, *B*. A beam of light comes horizontally from a lamp in the direction of *L* and encounters the half-silvered mirror, *H*, so called because it has a very thin film of silver on its shaded side. Here the beam is separated into two; one part is transmitted through the silver film toward *S*, and the other is reflected from the silver surface toward *T*. *T* is a totally reflecting mirror, its face is heavily silvered, and it is so set that the beam falling upon it from *H* is reflected back to *H* over the same path. This part of the beam penetrates the silver film of *H* and proceeds toward *O*. The other part also encounters a totally reflecting mirror at *S*, by which it is reflected back to *H* along the same path whence it came, and it is again reflected from the half-silvered mirror toward *O*. Thus, from *H* toward *O* the two beams travel the same path. But the beam going to *T* travels three times through the thickness of the glass, *H*, before arriving at *O*, while the other beam, that goes to *S*, passes through *H* only once. Consequently, there is a difference of path which would be troublesome if we did not equalize matters by introducing a compensating glass, *C*, of the same kind and thickness as *H*, and set parallel to *H*. If still there is a difference in path of an odd number of half-wave lengths between the double distances *HT* and *HS*, an observer in the direction *O*, looking toward *T*, will detect interference bands. If the light coming from *L* is the yellow light of a sodium flame, these interference bands will be alternately black and yellow; their width, shape, and direction will depend upon the orientation of the reflecting plane of the mirror, *T*, or *S*. If *S* has the direction of its plane fixed, small adjustments may be made in *T* by which we can arrange the bands to suit our purpose. Suppose we make them just wide enough so that the four black and four yellow fringes occupy the field of vision, in this case a surface equal to *S*; suppose we make the bands have straight edges and make them stand vertically in the field. If now we cause either *T* or *S* to move slowly parallel to itself, we find that a very small motion of the mirror causes a very large shifting of the bands to one side. In fact, a motion in *S* amounting to about 0.0003 mm. causes a pair of fringes to occupy the place of the next pair. Of course as much motion as this in the bands is perfectly evident to the naked eye, but by means of a telescope with micrometer eyepiece a motion in *S* of a hundredth part of that just named could be accurately measured, viz, three-millionths of a millimeter.

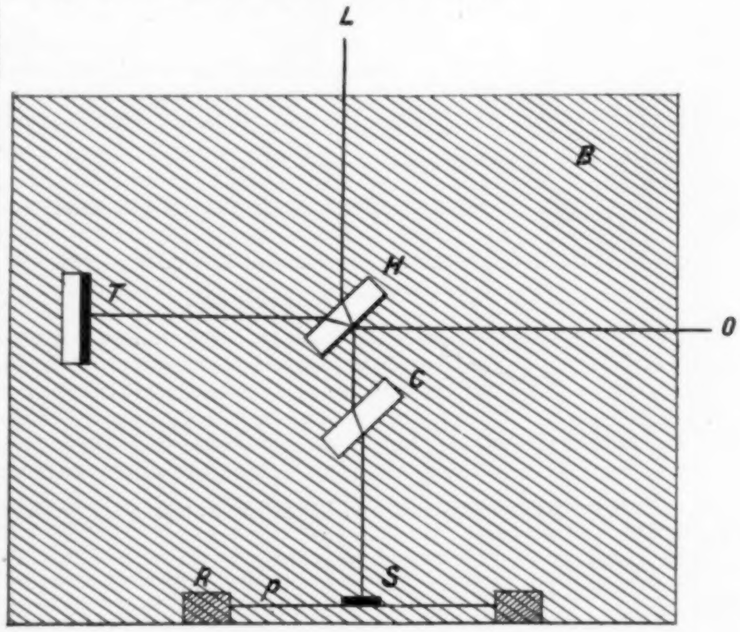


FIG. 1.—Plan of the refractometer.

Here is an extremely sensitive instrument for measuring small displacements. We will apply it to our purpose by mounting a very small and light mirror on the center of our sensitive plate, and by bringing this mirror into the position of *S*, fig. 1. The refractometer is shown in fig. 2,[1] uncovered and with its resonator removed. The little mirror is in place, and a ring, similar to the one on which the sensitive plate is mounted, lies in front. The resonator is mounted by screwing its ring into the same frame that supports the ring of the sensitive plate. A thin rubber ring serves as packing. If now the mouth of the resonator is corked, and the air within it is slightly compressed, the thin plate will bulge out a little, and the bands will be displaced, say to the right. But if the pressure within the resonator is slightly less than that without, the plate will bulge inward and the

[1] Helmholtz, Sensations of Tone. Second English edition, p. 373.

[2] Rayleigh, Theory of Sound, sec. 218.

[3] Michelson, "Interference Phenomena in a new form of Refractometer." American Journal of Science, 1882, (3), XXIII, p. 395. See also the mathematical treatment, by Professor Michelson in Philosophical Magazine, January-June, 1882, (5), XIII, p. 236.

[1] Figs. 2-12, 15, and 16 will found on Plates II, III, and IV.

bands will be displaced to the left, there being always a fixed ratio between the pressures and the motion of the bands. In this case the pressures can be measured with a water manometer.

Just here we have to meet the second part of our twofold, fundamental difficulty in measuring sound, for the pressures we have to measure in the resonator, due to sound, are not steady pressures such as we have just obtained by means of the air pump, but they are very rapidly alternating pressures, and even though our thin plate with its little mirror follows them perfectly, yet the motion of the interference bands from side to side is far too rapid for the eye to follow. But we can make the displacement of the bands a measurable quantity by aid of the simple principle of the composition of motions. To do this we place a screen in the path of the interfering light, as near to the half-silvered mirror as convenient. This screen has a narrow horizontal slit, so that the bands are cut down to a narrow strip. This viewed in the telescope appears as in the accompanying figure (fig. 3), and has a vertical height, o, measured in micrometer divisions. If now the object glass of this telescope is a small light lens mounted on the end of a tuning fork (which is electrically driven and is in such a position that the lens vibrates in a vertical line), the thin strip of bands will appear greatly elongated, as in the accompanying figure (fig. 5), for its vertical height has been stretched out by the changing refraction of the rays due to the motion of the lens, from o to Q. We have supposed thus far that no sound whatever disturbs the sensitive plate, but now we start a tone which has the same number of vibrations per second as the fork carrying the object glass. The vibrations of the little mirror, S, due to the tone, cause every point in the narrow strip to vibrate horizontally across the field, while the motion of the object glass causes every point to vibrate vertically at the same time. Consequently the composition of these two motions *may* result in an oblique line for each point, and the image of the bands *may* appear in the telescope as shown in fig. 6. In this figure the displacement, P, due to sound, is three and a half double bands; and it is related to α, the slope of the bands, in such a way that $P = B \tan \alpha$, in which $B = Q - o$.

A louder tone causes a wider displacement, P, and if the elements incidentally involved in the measurement remain constant, then the intensity of the tone will be proportional to P^2. This is equal to $B^2 \tan^2 \alpha$; hence, what we actually measure are o, Q, α, and the width of a band; so that P is determined in wave lengths of light. The eyepiece is specially constructed to measure angles, as well as lines in any direction. The displacements, combined with a knowledge of the pressures within the resonator necessary to produce them, give the intensity of sound in an absolute measure, i. e., in ordinary units of energy, such as ergs or foot-pounds. More exactly, it may be stated, that the motion of the little mirror fixed on the sensitive plate is calibrated in terms of pressures within the resonator, by means of comparison with the motion of a second plate of high pitch on which a steady pressure acts. This is necessary, because the rythmic pressure of a tone, well-timed to the natural oscillations of the plate, produces far greater displacements than a steady pressure of the same amount; just as a horse in trotting may give a bridge so much motion as to endanger it, while the weight of the horse standing still would produce no apparent bending. But if the second plate is only four octaves higher in natural pitch than the tone measured, the pressure may be measured statically with an error of less than four parts in a thousand. The mathematical theory by which these observations are made to yield an absolute measure of the intensity of a sound is a modification of that employed by Wien[1] for a similar purpose.

[1] Wiedemann Annalen, 1889, p. 835.

INCIDENTAL DIFFICULTIES OVERCOME.

The two fundamental difficulties have now been entirely removed. We have magnified the sound pressures and the displacements which they produce in spots of light, until the former can be accurately measured by means of the latter. But meanwhile we have met three incidental difficulties, each so serious as to threaten us with defeat. One of these is a little matter of difference in phase. It is stated above that the appearance of the image due to the double motion may be like that represented in fig. 5. But as a matter of fact the probabilities are very largely against its so appearing. For the composition of the double motion of the light and dark spots of fig. 3 into the straight lines of fig. 5 is due to the fact that a spot begins its motion to the right, for example, at the same instant that it begins to move downward. This is agreement in phase, for both of these independent motions are harmonic, or pendular. So, if we see fig. 5 in the telescope, it is because the source of sound is just far enough distant for a sound impulse to act upon the sensitive plate as the object glass is beginning one of its swings. But if the source of sound is moved a little from this position the two motions will be out of phase; and accordingly each spot of the strip will describe an ellipse of eccentricity depending on the phase difference, just as in the familiar case of Lissajous's figures for forks in unison. Evidently a very small amount of eccentricity will make the ellipses overlap and blur the edges of the oblique bands so completely that we can not set the spider line of our eye piece to the slope of the bands. Of course, a motion in the source of sound of less than a wave length of the tone may bring the two vibrations into phase again. But in a room, where such investigations are usually carried on, the reflections of sound from ceiling, floor, and walls, cause an additional disturbance in the form of standing waves, and consequently we would have to move the source of sound about in the three directions while seeking the positions that would give agreement in phase. This is extremely laborious, and thoroughly unsatisfactory; moreover it unduly limits the usefulness of the instrument. The phase of the object glass, on the other hand, may be varied by means of an adjustable self-induction (thrusting an iron core into a coil of wire in the circuit by which the tuning fork is driven) and in some other ways; but these variations are insufficient for all cases, and are therefore unsatisfactory. What we will do, then, is to make the tone and object glass differ slightly in frequency, by putting a small load, e. g., of adhesive wax, on the tines of the fork carrying the object glass. In this way we make the phases of the one oscillation overtake those of the other as slowly as we please; then in the telescope we will observe the bands sloping downward to the left, as in fig. 5, and after an interval of two or three minutes the bands will have the same slope downward to the right. Between these appearances confusion will reign, for during the interval the field is occupied by overlapping ellipses. But there is abundant time to make a careful measurement of the angle of slope at either extreme position, i. e., when the phases are identical, and when they are opposite. The angle in each case will be the same if only the tone is constant in intensity.

Another of these incidental difficulties was how to get a plate thin enough to be sensitive, homogeneous enough to vibrate in a symmetrical manner, and elastic enough to come to rest always in the same position. Ten substances were investigated without success, when finally the thinnest cover glass, for use with the microscope, was found to be satisfactory. Thus far glass has been employed as the most available substance for thin plates, though either steel, or gold of 14 karats, promises ultimately to prove superior.

AN INSTRUMENT TO PRODUCE PURE TONE.

A third incidental difficulty was a suitable source of sound, for we must produce our sounds as well as measure them. To investigate the fundamental laws of sound, it is important that our source produce a pure tone of very great constancy in pitch and in intensity. Besides, we must be able to vary its intensity at will between wide limits. Moreover, the source should afford a very definite point from which to measure its distance to the resonator of the refractometer. And, finally, the source should be very portable, so that this distance may be varied at will. No such instrument exists, so we must construct one. A tuning fork makes a good beginning, for it is very constant in pitch or frequency, and also tolerably pure in tone, its overtones being relatively weak. Moreover, the inertia of a heavy fork tends greatly to make its tone constant in intensity. But a fork alone will not serve our purpose, for at best we can not make a very loud sound with it, its overtones are somewhat objectionable, and there is no one spot whence the sound originates. So we will select a place on the fork which has a simple vibration and transmit its motion to a thin iron plate. This is done by fastening one end of a wire to the middle of the fork, which is a node for the fork's overtones, and fastening the other end of the wire to the center of the plate. The direction of the wire is the same as that of the motion of the fork, and perpendicular to the plate, so that the center of the plate is forced to vibrate exactly as the middle of the fork. But the plate itself is likely to have some overtones, so we will filter these out and greatly intensify the pure tone by making the plate a portion of the walls of another Helmholtz resonator, made and tuned to resound to the very tone which we propose to measure, which will be also the tone of the fork connected with it. This arrangement makes a very pure and effective source of sound. Simply tapping the fork with the finger makes a pretty loud sound, and the mouth of the resonator affords a definite center from which to measure distances; when in use a heavy padded box covers this instrument, excepting the mouth of the resonator, so that the tone emerges from the mouth only. A constant tone is produced by driving the fork electrically by a constant current. The intensity of the tone will depend on the strength of the current, which we can regulate at will. Moreover, the intensity of the sound can be defined in terms of the current effective in producing it. In other words the current can be calibrated in terms of the absolute intensities of the sound produced. This is done by means of the damping factors of the arrangement. The mathematical theory of this source of sound as an absolute measure is really only an extension of that given by Lord Rayleigh[1] for the tuning fork.

SOME USES FOR THESE INSTRUMENTS.

If we assume that the ear is constant and reliable we may employ it instead of the refractometer arrangement in connection with our source of sound in many important investigations. For example, we may investigate the variation of intensity with distance under various atmospheric conditions. To do this we place our source in a smooth open field when the air is free from wind and noise, produce a tone of small intensity and gradually withdraw until it is just audible; then we increase the intensity and again withdraw until it is just audible. This is repeated several times until we have withdrawn to the verge of audibility of the loudest pure tone which our instrument produces. Then a comparison of the intensities of the tone, with the corresponding distances of audibility will give the law that we seek. After such a law is established the distance at which two different persons can detect the same tone will give a numerical measure of their sense of hearing; and similarly the hearing of the two ears of the same person can be compared by stopping carefully one ear at a time. Tests of the hearing of a person in various mental and physiological conditions, as also for sounds of different pitch can be made. Moreover, the smallest change of intensity appreciable by the ear can be determined throughout a considerable range of initial intensities. By varying the intensity of the source, so that bare audibility is reached, we may likewise study problems of sound shadows, reflections, refractions, and (with two such sources, or a single source obstructed by a large building) interference. Thus our tone source may be of use both in the physiological and physical laboratories. By submerging this instrument in lake or sea, similar problems may be solved for water as the medium of sound. Of course we shall require one such instrument for every tone which we propose to use, though simply weighting the tuning fork gives a small range of frequency, sufficient to be appreciable as pitch.

But if, instead of using the ear, we eliminate its imperfections by using our receiving and measuring apparatus, we may solve a very large number of acoustical problems with great precision. In addition to those mentioned we may suggest: the distribution of sound in a large room, as well as the natural pitch and echo of the room; the wave lengths of various tones; combinational and differential tones; the viscosity of the air; the energy of the faintest tone that is audible. Considerable pains must be taken to prevent disturbing sounds from affecting the action of the sensitive plate. These sounds are transmitted both through the air and through the floor and supports. Insofar as they originate in our apparatus, we prevent them by employing tight, heavy boxes for coverings, and soft rubber piers for supports. Other sounds which come from the building or street can not be avoided altogether, except by working in the middle of a calm night. But even the tone to be measured should not have access to the side of the sensitive plate which bears the little mirror. Consequently the refractometer itself must be carefully boxed, so that only the mouth portion of the resonator protrudes; the refractometer also rests upon rubber piers.

ILLUMINATION.

Thus far it has been assumed that the light passing through the train of mirrors of the refractometer, and forming the interference bands viewed in the telescope, has its origin in a sodium flame. But, as a matter of fact, white light is used because of its greater intensity. Consequently the bands are not quite so simple as described, but instead of being alternately yellow and black, they are a series of rainbows with two black bands in the middle of the series. Elsewhere the very dark reds and blues serve the purpose of the black bands and afford a strong contrast to the brighter colors. In computation, of course, a mean wave length of light is employed. The source of the white light is a Welsbach gas lamp. It is very intense, constant, and quiet and serves the purpose excellently. No doubt an acetylene lamp would be convenient and satisfactory for out-of-door work.

A CAMERA TO PHOTOGRAPH SOUNDS.

For photographing sounds a good electric arc lamp is required, because the time of exposure is extremely short. Indeed the arrangement is quite different from the one used thus far in direct observation. The photographic film does not precisely take the place of the retina of the eye—but the telescope with its vibrating object glass is removed, and a single fixed lens is substituted, which focuses the interference bands upon the film. This film is wound about a horizontal cylinder kept in constant and rapid rotation, as was attempted

[1] Phil. Mag., 1894, p. 365.

by Raps.[1] Here again we make use of the principle of the composition of motions. Only in this case we have added to the lateral vibration of the bands, due to sound, a steady motion in the vertical direction, instead of an oscillatory one up and down. Consequently the result is different. The screen with the narrow horizontal slit is now set as close as convenient to the film, so that, with the cylinder at rest, and with no sound, a strip like fig. 11, only very much smaller, is focused on the film. If now the cylinder rotates, this strip will be continuously printed on the film, the result being parallel bands with straight edges, like the photograph of quiet, fig. 11. But any sound added now will cause a vibration of the points of the strip sidewise, and the result will be a set of parallel, wavy bands, such as in fig. 15 and fig. 16.

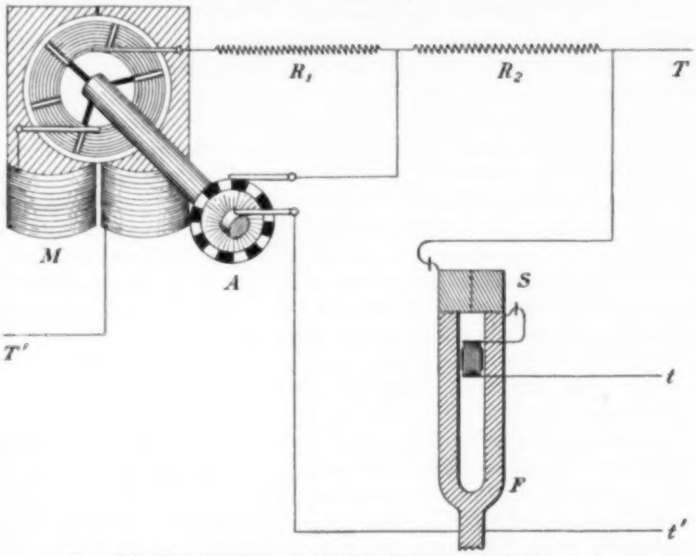


FIG. 13—Device for regulating the speed of the motor.

The accompanying fig. 12 shows the inside of the camera. The lid has been removed and the back let down. The cylinder is shown belted to a small dynamo, which is almost completely covered with black cloth to prevent its sparking from fogging the film. But the pulley is shown, with black and white sectors upon its face. This is part of a stroboscopic device to observe and regulate the speed of the motor. Opposite this disk is a ruby glass window in the camera, for the purpose of viewing the disk. But this inspection is made between the tines of another tuning fork in vibration, as shown in fig. 13. Two little screens, S, are fastened to the ends of the tines in such a way that they barely meet when the fork is still, but in vibration, slide over each other without touching. Thus the view is interrupted once during each complete vibration. Now, if the disk turns just fast enough for one of the black sectors to advance to the position of the next, during the interval that the screens are closed, of course the disk will appear to be at rest. This rate of motion is secured by feeding the motor with a constant current of just the right strength. This again is no easy matter, but a continental scientist, Lebedew,[2] only a short time ago, devised a method of accomplishing it satisfactorily. His method consists in the arrangement shown in fig. 13. The current through the motor enters at T and passes out at T^1. In so doing it passes constantly through the resistance, R_1, which is not quite large enough to slow down the motor as much as desired. R_2 is a second resistance, which, added to R_1, would slow down the motor too much. But a shunt, through the tuning fork, cuts out R_2 periodically, that is, for a portion of each fork period, thus bringing down the average resistance to the required amount; for the shunt circuit is regularly opened and closed at two places: at the upper platinum connection on the fork, and again at the accessory commutator, A, of the dynamo. If the shunt is closed at both places during the same interval, evidently R_2 is shunted out during this interval, and the motor gains in speed. But if the connection is broken at one or the other of these two places during the entire period of a fork vibration, then the current must pass through both resistances, R_1+R_2, and the motor is slowed down. Accordingly an automatic balance can be found between these two tendencies, by adjusting R_1, R_2, and the platinum contact, such as will give constantly the speed desired. The regulation is automatic, because the acceleration of the motor itself puts in more resistance, and vice versa. The fork, F, is driven by an independent current, and is provided with a box having glass windows, as in the case of the fork of the object glass. By suitable pulleys, a speed of about three revolutions per second is given to the cylinder, and since the shutter slit is less than a half millimeter in vertical width, and the cylinder is 50 centimeters in circumference, it is evident that the time of exposure is less than one three-thousandth of a second; consequently a very intense light is required.

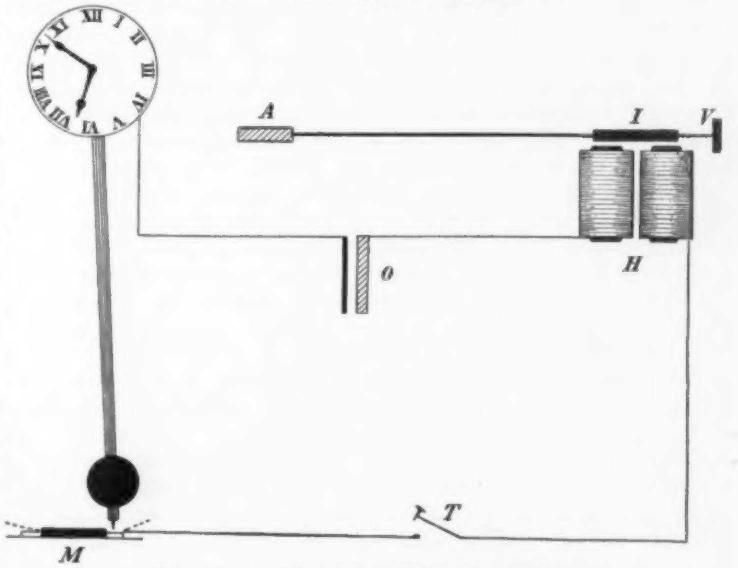


FIG. 14.—Device for opening the shutter.

But the time of exposure differs from the time that the shutter is open, for during this interval a series of pictures of the size of the shutter has to be made entirely around the cylinder, unless we wish to waste our film by blank spaces, or by overlapping pictures. It is therefore, desirable that we make the shutter open for precisely a third of a second at each exposure. This is done by the device represented in fig. 14. The shutter, A, is at the end of a long lever, operated by an electro-magnet, H. The armature, I, has a hinge motion by means of the thin, flat spring, V, which is firmly clamped at the end represented toward the right-hand of the figure. The current from the battery, O, passes down the pendulum of the clock, which beats seconds, and around through the electro-magnet, provided that the platinum point of the pendulum happens to be passing through the mercury, M, and provided also that the key, T, is closed. We adjust the width of M so that the pendulum is in contact with it during about half of one swing; then, to make an exposure we close the key at the beginning of a swing in either direction, taking care to open the key when the swing is completed. This is best done by having the clock where we can see it. The ticking is no disturbance, for it dies away before the shutter is opened.

THE UTILITY OF A CAMERA FOR SOUNDS.

With such a camera we may photograph sounds of any

[1] Wied. Ann., 1893, Band 50, p. 194.
[2] Wied. Ann., 1896, Band 59, p. 118.

sort. Fig. 15 gives a number of photographs of tones and combinations of tones. The straight, narrow, white line along the middle of each photograph is produced by the shadow of a fine wire, stretched vertically across the middle of the narrow slit of the camera. This line is not shifted with the bands, so it affords a convenient position from which to measure the displacements of the bands. When picture No. 1, fig. 15, was taken the room was very quiet, so far as the ear could discern. But it appears that the instrument was more sensitive than the ear, for otherwise these lines would have been as straight as the reference line. Instead they show small oscillations of the little mirror, and therefore a sound is revealed. A strong tone causes a wide displacement, like No. 12, while a weak tone causes less displacement, as in No. 13. If the tone is high in pitch, the wave length is short, like No. 8, but a low tone gives a long wave, like No. 6. By comparing the number of waves in a given length we find that the flageolet was blown on F in the fourth octave above No. 6. This fact could not be determined by the ear. Again the flageolet was blown with utmost intensity and produced a painfully loud and shrill sound, while the tuning-fork of No. 6 was touched very gently and its tone sounded very faint to the ear. Yet the displacements are evidently much larger than in No. 5, and accordingly a tone of low pitch has in it more energy than one of high pitch, since the energy is proportional to the square of the displacement; hence the ear must be more sensitive to high tones. In taking all these pictures the influence of the resonator was eliminated by removing the resonator. This was done by simply screwing it off and leaving only the sensitive plate. It was desirable to know the natural pitch of this plate loaded with the little mirror. This was accomplished by opening the shutter of the camera just after fanning the plate once gently. The motion of the air displaced the plate slightly, and in coming to rest it swung to and fro in its own natural period. This is shown well in No. 3, and by counting and comparing wave-lengths again we find its pitch is G flat, or about 186 vibrations per second. The record begins on the right-hand of each figure, and the motion was at first somewhat irregular, because the air near the sensitive plate was still disturbed by the fanning. But it appears that, as we proceed to the left, the plate soon settles down to a regular motion. This photograph is selected to show how this motion begins, and is taken from a film twenty inches long. It would appear from the pictures produced by tuning forks sounding together that a discord, like No. 11, gives sharp waves, while for forks in harmony the combined waves are round and smooth, as in No. 12. The perfection of our source of tone is shown in No. 13.

It will assist in forming a conception of what is represented in these photographs, if we place these long bars in a vertical position before the face. Then, if the film were at rest, and if the exposure was extremely short, the picture of the interference bands would be like a strip cut out horizontally across one of these bars, less than a half millimeter in vertical height. The picture contains the exact position of the interference bands at that instant. Now, suppose the film is moving rapidly upward. At each successive instant the photographic film records the changing position of the bands, because the vertical position of the strip on the film is changing simultaneously. Consequently, each photograph is a chart, showing continuously the changes in atmospheric pressure due to sound.

The cylinder covered with the film is moved along in the direction of its axis after each complete photograph, by turning up the screw shown in connection with the camera. Its handle projects to the right, and its point bears against the base of the carriage which carries both cylinder and motor. This carriage slides smoothly and easily upon the base of the camera, by the motion of the screw, without opening the camera or stopping the motor. With this apparatus 10 feet of such sound photographs have been taken in as many minutes with a simple arrangement for winding a long, narrow film continuously from one cylinder upon another, a similar photograph may be taken of an entire oratorio or address.

Fig. 16 represents photographs of the vowel sounds occurring in the words indicated.[1] These vowels were sung by the author as distinctly as possible, but rather softly, upon the note an octave below middle C, or upon the C, having 128 vibrations per second. The resonator had been removed, as before, so that the sound waves acted directly upon the sensitive plate. Each vowel is represented by seven complete waves. The degree of smoothness of utterance in each case is shown by the uniformity of these waves. Ideally, every wave in each curve should be exactly alike, though each curve should be characteristic of the vowel. Of course, the height of the waves may change, for that depends simply on loudness. The length of the waves depends on the pitch on which they are uttered, and that may change too, as indeed it does, in the inflections of speech. Moreover, since different people have individual peculiarities of speech, so that they do not pronounce the same vowel exactly alike, these vowel curves are actually somewhat different in other respects also, for different people, and even for the same person under different conditions, mental and physiological.

THE ANALYSIS OF PHOTOGRAPHS OF SOUND.

The analysis of vowel curves shows that their characteristic differences consist in the relative predominence of one or more overtones. But this statement should not lead any one to make a crucial test by attempting to construct a vowel by any combination of notes on any musical instrument. For each note is itself a whole symphony of overtones, and any addition of them would be haphazard. But even a carefully studied combination of tuning forks, though it affords a recognizable vowel in the simpler cases, is subject to some limitations, so that it would not sound entirely human.[2] It seems then that the synthesis[3] of vowels is practically more difficult than their analysis. A number of very complicated machines have been constructed for analysis.[4] A recent one, by Professor Michelson, separates a curve into 80 harmonic components.[5] To prepare one of our vowel curves for his "Harmonic Analyzer" we would enlarge it considerably, e. g., by projection with the lantern, trace it on sheet metal and cut it out. The wavy edge is then fed into his machine, and for a result we obtain numbers representing the proportional strength of the first 80 overtones. A wonderful machine!

From any of our sound photographs a measurement can be made of the intensity of sound, on virtually the same plan as the one already mentioned, that is by the displacement of a given band from its mean position. This displacement is read by means of a micrometer microscope applied to the film itself, or by means of a lantern projection. We have already ascertained that each displacement of the bands corresponds to a definite motion of the sensitive plate which carries the little mirror. A mathematical relation connects this motion with the condensation of the air within the resonator, another relation connects the condensations within with those without; so that, thus, there is a complete chain of relations,

[1] Cf. Hermann's work, Phonophotographische Untersuchungen. Bände 53, 58, 61, Archiv für Physiologie.

[2] Helmholtz, Sensations of Tone. Note by Ellis. p. 543.

[3] Preece and Stroh. Proc. Roy. Soc. Vol. XXVIII, p. 358.

[4] Jenkin and Ewing. Trans. Roy. Soc. Edinb. Vol. XXVIII, p. 745.

[5] A. A. Michelson and S. W. Stratton. A New Harmonic Analyzer. Am. Jour. Sci., January, 1896, (4) V, pp. 1-13; also L. E. D., Phil. Mag., January, 1898, (5), XLV, pp. 85-91.

having at one end the displacement of the bands, and at the other the energy in the sound.

Besides all the various physical and physiological problems before mentioned in this paper, whose data may be obtained in permanent records, some additional ones may be attacked with this photographic apparatus. For instance, it will be of interest to know why the same note on two different musical instruments, e. g., violin and flute, should be so different in quality. The comparison of photographs of these sounds would answer the question. Similarly we may investigate the physical peculiarities of any sound produced by man or in nature.

RAINFALL AND TEMPERATURE IN NICARAGUA.

By A. P. DAVIS, Hydrographer, United States Geological Survey.

The Nicaragua Canal Commission made certain investigations of the climatology of Nicaragua in 1898. Their observations, being confined to data bearing upon the problem of an interoceanic canal, did not include barometric investigations. Rainfall, temperature, and humidity observations were made at a number of stations, mostly in the vicinity of the proposed canal line, and well distributed between the Atlantic and Pacific. The form of rain gage used at most of the stations was a metal funnel, which caught the rain and discharged it into a bottle, from which it was measured in a graduated glass bearing a known relation to the diameter of the funnel. The gage was always placed in a position as exposed as possible; but nearly always this was a small clearing in the forest, which was still well sheltered from the wind.

One of the most remarkable characteristics of Nicaragua is its rainfall and the radical and striking differences in amount and distribution of precipitation on the east and west coasts. From the rainfall tables it will be seen that at Greytown, on the Rio Deseado, and other points near the Atlantic there is no definite dry season, but that rain may be expected any day in the year, and the expectation will seldom be disappointed. On the Pacific coast, on the contrary, there is no rain from the beginning of the record in January until the middle of May, when the rainy season begins, after which it is subject to violent downpours throughout the rainy season, the precipitation for a single day observed at Brito, on the 23d day of May, being 5.06 inches.

No less remarkable is the excessive aggregate of rainfall in a limited district of which the nucleus seeme to be in the vicinity of Greytown. The annual rainfall at this point, as deduced from the mean of four years' observation, is about 250 inches, while that at Bluefields is only about 90 inches, at Port Limon somewhat less, and at San Jose de Costa Rica about 68.

While there is a slight increase of rainfall with altitude at the headwaters of the Deseado and San Francisco, yet, in general, it may be said that the rainfall decreases as we pass up the San Juan River. No definite limit can be assigned, with present information, to this district of excessive rainfall, nor is it known in what ratio precipitation decreases to the northward and southward.

The dividing line between the characteristic climates of the east and west is not definite, but may be said, in general, to approximately coincide with the range of mountains known in canal literature as "the Eastern Divide." The portion west of this divide partakes of the characteristics of the Pacific slope, having a comparatively moderate precipitation and a definite division of rainy and dry seasons, while the territory east of this divide has no well-defined dry season and has much heavier rainfall than the west side. The exception to this rule is the valley of the San Juan. As we proceed up this river the rainfall decreases rapidly and almost uniformly, but the dry season is by no means well defined and rain may be expected in any month.

Thus, so far as quantity and distribution of rainfall alone is concerned, the conditions are rather unfavorable to the requirements of the canal. The heaviest engineering constructions are to be on the east side, where the rain is excessive and persistent, thus interferring with construction and with the permanence of the works. On the other hand, the entire basin of Lake Nicaragua, upon which the canal must depend for its water supply, is affected by a long, dry season, in which evaporation from the lake is greatly in excess of the inflow, and storage must be provided to overcome this drain.

On the west side, including the basin of Lake Nicaragua, the dry season begins in December and ends in May—being ordinarily from one to two months shorter than the rainy season. During the latter part of the dry season the inflow to the lake becomes very slight, many of the tributaries, though wide and deep, are filled with stagnant water, upon which grows enormous masses of floating vegetation, which discolors the water, renders it foul, and obstructs navigation. When the rains begin in May or June these streams are swollen to almost torrential proportions and flow with strong currents far out into the lake, carrying great masses of vegetation or floating islands, sometimes acres in extent, which form large crescents around the mouths of the streams and become a source of serious annoyance to the steamers plying on the lake. These floating islands are eventually broken up by the winds and waves of the lake, and such parts as are not discharged through the San Juan River decay in the lake.

Records of rainfall for numerous stations in Nicaragua were published by Mr. A. J. Henry in the MONTHLY WEATHER REVIEW for July, 1898, pages 304–306. Since that date some additional information has been received, making a complete record of nineteen years at Rivas and four years at Greytown. The Rivas record is from 1880 to 1898, inclusive, and the Greytown record is for the years 1890, 1891, 1892, and 1898. The contrast of climatic conditions on the two sides of the Isthmus is further illustrated by an examination of these records. The year 1890 shows the smallest precipitation of any of the nineteen years recorded, being only 31.80 inches, while in the same year 296.94 inches fell at Greytown, this being the maximum observed at that point. In the year 1898 the precipitation at Greytown was 201.64 inches, the lowest in the record, while at Rivas in that year 108.06 inches fell, this being one of the highest in the Rivas record. These facts suggest that perhaps there is a compensating influence at work and that the same cause which produces a year of small precipitation on one side operates in the reverse direction on the other.

Monthly rainfall in Nicaragua during 1898.

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Brito	.25	.00	.08	.08	11.30	14.86	11.42	6.18	16.82	25.70	6.01	2.41	95.11
Las Lajas	.25	.05	1.34	.28	10.60	13.50	10.64	8.44	6.79	16.19	4.41	2.26	74.75
Rio Viejo	.04	.01	.66	.00	13.78	13.45	4.01	11.66	7.28	8.99	0.61	0.17	60.66
Tipitapa	.26	.00	.26	.00	8.56	16.88	6.24	7.82	11.25	7.12	0.98	0.17	59.49
Morrito	.....	.....	.....	.07	8.92	14.05	13.84	10.20	.....	.....	.....	.....	.....
Fort San Carlos	.....	.....	1.21	3.00	8.22	15.56	13.35	8.00	10.56	8.93	9.86	5.62	84.31
Sabalos	.....	.....	2.10	6.00	11.69	17.13	20.69	11.33	11.42	11.81	12.17	10.20	104.54
Castillo	.....	.....	.....	.....	.....	.....	18.92	11.46	16.22	2.99	14.04	11.64	.....
Machuca	.....	.....	.....	.....	.....	.....	.....	6.52	12.86	9.83	15.65	.....	.....
Rio San Carlos	.....	.....	7.52	11.67	20.13	20.73	18.26	11.68	.....	.....	.....	.....	.....
Ochoa	13.07	14.07	8.04	12.22	15.24	21.44	21.58	12.06	15.12	8.02	21.50	8.38	170.74
San Francisco*	15.33	18.43	8.72	11.25	13.87	18.87	19.22	13.45	10.95	9.09	22.38	10.61	172.17
Sarapiqui	.....	.....	.....	.....	.....	.....	.....	.....	11.19	11.35	18.63	7.12	.....
Deseado†	21.92	26.98	11.76	8.83	14.84	18.66	26.86	13.31	5.23	11.92	29.25	21.07	210.63
Greytown	19.44	25.17	10.16	7.82	9.37	19.52	24.63	16.38	7.24	12.50	32.35	17.06	201.64

*Record incomplete from January 1 to 5, inclusive, and from December 29 to 31, inclusive, so the rainfall at Ochoa for those days is added.

†Rainfall not observed from December 25 to 31, inclusive, so the record was completed by including the corresponding days for 1897.

TEMPERATURE AND RELATIVE HUMIDITY.

The temperature of Nicaragua is remarkably uniform.

While some of the higher mountain regions have a rather cool climate, there is never any frost, and in general it may be said that in the habitable region of the republic the temperature seldom exceeds 90° Fahrenheit or falls below 70°, and in any given locality the annual fluctuation is sometimes still less. The relative humidity is high in all of the uniformly high temperatures, excepting during the dry season on the west side of the isthmus.

Observations of wet and dry bulb thermometers were carried on at the station on the Rio Grande, at Las Lajas, Rio Viejo, Fort San Carlos, Sabalos, Rio San Carlos, Ochoa, Deseado, and at Greytown, and the results are given in the following tables.

Temperature and relative humidity at Las Lajas, on western shore of Lake Nicaragua, 1898.

Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.	Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.
	°	°	°			°	°	°	
February	80	75	77.7	81.1	August	85	74	80.7	87.0
March	84	75	79.5	79.3	September	85	73	79.4	90.4
April	86	77	80.8	79.1	October	......	......	......	......
May	91	73	82.1	83.0	November	86	73	79.3	89.7
June	91	73	81.4	84.8	December	83	73	78.3	91.1
July	85	74	79.7	86.6					

Temperature and relative humidity at station on Rio Viego, at crossing of Matagalpa Leon road, 1898.

Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.	Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.
	°	°	°			°	°	°	
February	89	63	78.1	58.9	June	94	70	80.6	81.4
March	97	62	78.8	59.1	July	89	70	78.8	79.6
April	94	69	82.8	59.4	August	90	71	78.4	83.1
May	96	71	82.3	71.0					

Temperature and relative humidity at St. San Carlos, on eastern shore of Lake Nicaragua, 1898–99.

Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.	Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.
	°	°	°			°	°	°	
March, 1898	88	70	78.1	......	September	90	72	79.6	87.3
April	89	70	78.5	79.1	October	90	74	79.1	88.5
May	91	75	80.0	85.9	November	89	72	77.9	90.1
June	90	75	79.5	88.9	December	88	70	76.5	88.8
July	90	72	78.2	88.9	January, 1899	84	69	75.9	90.5
August	89	72	79.3	89.5					

Temperature and relative humidity at Camp Sabalos, on San Juan River ⅛ mile above Torro Rapids, 26 miles from Lake Nicaragua, 1898–99.

Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.	Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.
	°	°	°			°	°	°	
February, 1898	90	67	75.5	87.2	August	87	70	77.5	91.0
March	90	69	76.7	84.8	September	90	71	78.6	87.4
April	89	66	76.8	85.3	October	90	71	78.2	87.4
May	89	71	77.8	87.8	November	88	68	77.0	90.4
June	89	71	77.7	90.0	December	86	65	75.6	89.0
July	89	71	77.1	92.0	January, 1899	86	66	75.2	90.7

Temperature and relative humidity at Ochoa, on San Juan River, 40 miles from Caribbean Sea, 1898.

Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.	Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.
	°	°	°			°	°	°	
January	83	66	73.9	91.6	July	89	70	76.6	91.5
February	85	66	73.3	90.4	August	87	71	77.0	91.4
March	87	67	75.1	87.6	September	91	70	77.5	89.6
April	88	66	75.8	88.8	October	95	71	71.2	89.4
May	94	72	78.3	90.0	November	89	70	76.1	92.0
June	96	71	77.5	90.7	December	85	67	75.1	91.0

Temperature and relative humidity at station on Deseado River, 10 miles from Caribbean Sea, 1898.

Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.	Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.
	°	°	°	°		°	°	°	°
January	86	65	74.1	94.7	July	85	73	78.1	92.2
February	84	66	74.1	90.2	August	87	73	78.3	91.8
March	87	68	77.2	84.7	September	91	73	79.8	86.8
April	87	67	78.8	85.2	October	89	72	79.5	88.8
May	91	72	79.5	89.4	November	88	71	76.8	94.3
June	86	73	78.9	91.0	December	84	66	76.1	94.0

Temperature and relative humidity at Greytown, Nicaragua, 1898.

Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.	Month.	Temperature. Maximum.	Temperature. Minimum.	Temperature. Mean.	Mean relative humidity.
	°	°	°	°		°	°	°	°
January	86	67	77.5	82.5	July	90	74	80.0	91.3
February	84	71	77.1	81.7	August	96	73	80.0	84.9
March	90	69	78.4	80.2	September	96	72	81.2	85.0
April	89	69	79.9	79.0	October	96	72	81.4	84.8
May	94	73	80.4	82.1	November	92	72	79.7	87.7
June	90	72	79.3	91.4	December	91	72	78.3	88.0

NOTES BY THE EDITOR.

THE PACIFIC COAST DIVISION OF THE CANADIAN METEOROLOGICAL SERVICE.

Referring to an article by the Editor on page 102 of the MONTHLY WEATHER REVIEW for March, the reader will notice that we spoke only of the proposed system of daily forecasts that now emanate from the Central Office of this Division, at Victoria, B. C. But in addition to the forecasts, we are also interested in the general development of meteorological work in that section. On this point Professor Stupart informs us that—

Since July, 1890, Mr. Baynes Reed has been in charge of the Canadian meteorological chief station on the Pacific coast. Last year his station was moved from the suburb of Esquimalt to the City of Victoria and became the head office of the Pacific Division of the Canadian service with Mr. Baynes Reed still in charge. Mr. F. Napier Denison, late of the Toronto office, has been assigned as his assistant. Mr. Reed has been indefatigable in his endeavors to secure volunteer observers in British Columbia, and to his labors, combined with the valued coop-

eration of the Provincial Department of Agriculture, is due the fact that the Pacific province has now a very large number of meteorological stations.

The immense territory covered by the Canadian Meteorological Service demands a correspondingly large number of voluntary and regular stations, in order to properly present its climatology in relation to agriculture, forestry, hygiene, and all human industries. A few such enterprising men as Mr. Baynes Reed, in charge of the respective divisions of the Canadian Service, would accomplish all that it is possible to do for the climatology and meteorology of the Dominion. Observers, clerks, computers, and forecasters, all alike feel the stimulating influence of an energetic chief.

Our readers will be interested in the short description of the general organization of the Canadian Service, published on a preceding page, from the pen of Prof. R. F. Stupart, who has been Director of the Canadian Service and Superintendent of the Magnetic Observatory at Toronto, since January, 1895, after a previous service of several years, first as assistant and then as acting director during the illness of his predecessor, Professor Carpmael, who died in October, 1894.

"SCIENTIFIC AIDS" IN THE DEPARTMENT OF AGRICULTURE.

Doubtless there are many observers in the Weather Bureau, both regular and voluntary, who have studied at agricultural colleges, experiment stations, or land grant colleges, and who will be interested in the following letter from the Honorable Secretary of Agriculture and the circular of the United States Civil Service Commission, which we publish in full.

In this letter our readers now have a statement from the highest authority as to the needs of the various bureaus of the Department of Agriculture, and will perceive the importance of the step that has been taken to educate men competent to give satisfactory service. The Department includes workers in every branch of biology and physics, and even mathematics; men who have to apply their knowledge to meteorology, the diseases of animals and plants, the cultivation of the ground, the manufacture of the completed product from the crude material, the irrigation of dry land, the construction of roads, the proper handling of statistics, and many other practical matters.

We can but believe that the Secretary has taken the very best possible way to secure able men and educate them to the special work of his broad service. It is a long step toward realizing that ideal "University of the United States," and the educational system to which we alluded on pp. 63, 64, 548, and 564 in the MONTHLY WEATHER REVIEWS for February and December, 1898.

(Copy P.)

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., June 10, 1899.

Hon. JOHN R. PROCTER,
President Civil Service Commission,
Washington, D. C.

DEAR SIR: In my report to the President of the work of this Department for the year ending June 30, 1898, I proposed that the Department should receive from time to time graduates of agricultural colleges, who should come to work in the scientific Divisions of the Department, and at the same time pursue post-graduate studies, thus taking advantage of the facilities which the Department has for advanced study and fitting themselves for posts of usefulness in the Department, agricultural colleges, experiment stations, and other institutions throughout the country requiring the services of persons able to make original researches in lines related to agriculture. This plan met with much approval from the officers of the agricultural colleges and experiment stations and others interested in the advancement of agricultural science and practice in this country, and I therefore wish to put it into actual operation as far as existing conditions in the Department will permit.

In order to have a permanent arrangement for the registration of graduates of colleges desiring to enter the service of the Department as scientific aids, and to furnish a proper basis for the selection of candidates best fitted to meet the needs of the Department for assistance in different lines of scientific work, I respectfully request the Commission to establish a register of "Scientific Aids" for this Department on the following basis:

1. That the candidates be limited to graduates of colleges receiving the benefits of grants of land or money from the United States.
2. That each candidate file with the Civil Service Commission a properly certified statement as to the length of time spent in college, the studies pursued, the standing in these studies, the special work it is desired to take up, and the special qualifications for such work, and finally a thesis upon such special scientific subject as the candidate may select, or in lieu of this any literature on scientific subjects published over his own signature.
3. That the weights for the aforesaid evidences of qualifications be arranged on the following basis: College course, with Bachelor's degree, 50; post-graduate course and special qualifications, 25; thesis or other literature, 25.
4. That the length of time any "Scientific Aid" may serve in the Department be limited to two years.
5. That the salary shall not exceed $40 per month.
6. That an eligible register of "Scientific Aids, Department of Agriculture," be kept by the Commission and be open to inspection of the Department officers, as in the case of the list of "Assistants, Department of Agriculture."

I desire that this plan, when approved by the Commission, shall be put in operation without delay, and for this purpose request that you will send me 100 copies of such public notice as you send out regarding the establishment of this register, in order that I may transmit it to the presidents of the colleges concerned, with a statement of the needs and limits of the Department in the employment of their graduates in this way.

Very respectfully,
(Signed) JAMES WILSON,
Secretary.

Series No. 1.
June, '99.
Sheet 1.

UNITED STATES CIVIL SERVICE COMMISSION.

DEPARTMENTAL SERVICE—SCIENTIFIC AID EXAMINATION.

DEPARTMENT OF AGRICULTURE.

Competitor must fill these blanks.	Name	P. O. address ....
	County	State ....

(N. B.—The competitor will not write in the form below.)

REPORT OF MARKS.

WASHINGTON, D. C., ——— —, 189-.

Subjects.	Averages.	Relative weights.	Products of averages multiplied by weights.
First—College course with bachelor's degree..		10	
Second—Post-graduate course and special qualifications		5	
Third—Thesis or other literature..............		5	
Total..............		20	
General average			

Avoid all allusions to your political and religious opinions or affiliations in any material which is submitted with this sheet.

Competitors will not be assembled for any of the tests.

PRELIMINARY QUESTION.

Give the names and addresses of five persons (not relatives) who have a personal knowledge of your educational and special qualifications and who will answer questions regarding them.

FIRST SUBJECT—COLLEGE COURSE WITH BACHELOR'S DEGREE.

Furnish a certified statement from the proper college or university officer relative to any diplomas or certificates of graduation you have received conferring scientific, literary, or other degrees, and stating fully the length of time spent in the college, the studies pursued and the standing in these studies.

SECOND SUBJECT—POST-GRADUATE COURSES AND SPECIAL QUALIFICATIONS.

Make a complete statement of any post-graduate course you have pursued or work you have done. State particularly any special qualifications you possess which in any way fit you for the duties of scientific aid and the special work you desire to take up.

THIRD SUBJECT—THESIS OR OTHER LITERATURE.

Submit a thesis of not less than 2,000 words on any scientific subject, or, in lieu thereof, any other literature or publications on scientific subjects which you have prepared.

JURAT.

(The following oath must be taken before a notary public or other officer authorized to administer oaths for general purposes, and the officer's signature must be authenticated by official seal. If the oath be taken before a justice of the peace or other officer who has no official seal, his official character must be certified by the clerk of the court, secretary of state, or other proper officer, under official seal.)

I, the undersigned, do solemnly swear (or affirm) that in the preparation of the accompanying thesis, or other literature required under subject three, the composition is entirely my own, and that I have given full credit, by quotation marks or references, to authorities for any quoted matter.

(*Signature of competitor*:) ——— ———.

Subscribed and sworn to before me by the above-named applicant, to me personally known, this ——— day of ———, 189–, at ———, county of ———, and State [or Territory or District] of ———.

(*Signature of officer*: ——— ———.

[OFFICIAL SEAL.] (*Official title*:) ——— ———.

The official seal must not be omitted.

RECORDS BY THE MILNE SEISMOGRAPH.

On Plates V and VI we have reproduced a number of facsimiles of the records made by the Milne seismographs that are established and kept in working order by the Canadian Meteorological Service at its stations in Toronto and Victoria, B. C. It is very much to be hoped that similar apparatus will be established at a few places in the United States for the purpose of tracing the progress of the undulations that run around the whole globe whenever an earthquake of any importance occurs. If it were desired to investigate the phenomena of the smaller local earthquakes an instrument of different pattern and more numerous stations would be required. Studies of this local nature have been already undertaken in many countries, but the establishment of the Milne apparatus, which is now set up at about twenty stations, is in accordance with an international scheme which looks to the study of the exceedingly minute oscillations that extend to great distances from any center. Both the general and the local disturbances must be studied in order to prepare the way for any system of forecasting earthquakes, or the erection of earthquake-proof buildings and monuments. There can be no doubt but that seismic disturbances originate in a variety of ways and have a corresponding variety of phenomena. When an eruption is about to occur from a volcano there are short severe shocks in rapid succesion, comparatively near the surface and not liable to be felt many miles away. When the general geological strata are strained and eventually crack, and slide over each other, a slower dislocation, or so-called fault, is produced. This involves the movement of a large mass, oftentimes at considerable depths in the earth, and the disturbance or wave of shock may be felt for several hundred miles, while a gentler wave or oscillation may run entirely around the globe, and, perhaps, even several times around. When such a wave passes a distant station, it simply produces at the surface of the ground a slight undulatory movement, although far beneath the surface the movement may be one of compression and rarefaction. The Milne seismograph is adapted to record this gentle undulation or tremor, by which the surface and all objects standing upon it are slowly tipped forward and backward as the successive waves pass by the spot, for it generally happens that a single wave can not travel alone, but is preceded and followed by smaller waves, so that the whole series forms a group. Our diagrams show such groups of waves on January 24, April 16, June 4, 5, and June 14, all in the present year.

The apparatus with which these records are made is called the horizontal pendulum seismograph. It was invented by Prof. John Milne, and general descriptions of its construction, as well as of the work done by the British Association for the Advancement of Science, through its various committees on seismological observations, are given in successive annual reports of the Association, especially those for 1896–97–98. Some idea of the apparatus is given by fig. 1, in which we see that when the horizontal beam, technically called a boom, which is made exceedingly light and is about 30 inches long, remains stationary, then the light of the lamp reflected downward from the mirror is photographed upon a strip of paper that is moving slowly along below it. This is the central black line shown on Plates V and VI. If the supporting stand is disturbed, the longer end of the boom oscillates horizontally like a pendulum, producing the broadenings of this line. The boom gradually comes to rest and so remains until another disturbance occurs, and the line again broadens. Our illustrations show that the shocks come sometimes in such rapid succession that the boom has no chance to come to complete rest between each shock; thus an earth tremor can usually be analyzed into a series of increasing and decreasing oscillations.

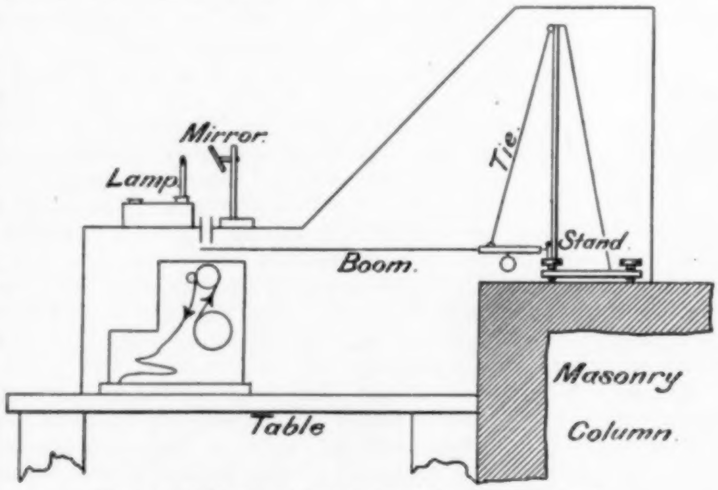


FIG. 1.—Milne horizontal pendulum seismograph.

When the Milne apparatus is first set up there is apt to be need of adjustment almost daily, owing to the fact that the masonry column and the soil beneath it is undergoing a slight progressive change. It takes a long time for a newly built column to come into a permanent quiescent state. Again, there are many localities in which the geological strata are apparently undergoing a slow progressive deviation from horizontality. Mr. Milne mentions such in the Isle of Wight, where the shocks are too local in their character to be called earthquakes. Mr. G. K. Gilbert, of the United States Geological Survey, has argued with some plausibility that the whole region of the Great Lakes is being slowly canted toward the south-southwest (see MONTHLY WEATHER REVIEW, April, 1898, p. 164), at a rate which he expresses in inches, for a base line of 100 miles, but which may also be expressed in angular measurement, and is equivalent to a rate of 0.15 seconds of arc in a hundred years at the slowest, and 0.50 seconds at the fastest. Even this exceedingly slow movement could be made appreciable to a Milne seismograph, which is ordinarily so adjusted that half a second of arc corresponds

to a movement at the end of the boom of one-twenty-fifth of an inch, and it can easily be made more sensitive. This instrument is not sensitive to sudden, quick shocks transmitting short elastic vibrations that are not in harmony with the natural time of vibration of the boom itself. Thus the blasting of powder, the heavy rumbling of wagons, the firing of artillery have little or no effect in producing a swing of the boom. The ordinary time of oscillation for a light boom is about one and one-half minutes; but for a heavy boom it may be five minutes before it comes to rest. Our illustrations show many cases in which the boom did not come to rest before a new oscillation began. The time required for it to come to rest in the Toronto instrument is apparently a little longer than the case of the Victoria apparatus.

Professor Milne remarks that inasmuch as ordinary pendulums, chemical balances, and magnetometers show appreciable motions going on (although shut up within a box to protect them from draughts of air) so, in the case of the horizontal pendulum, motions may be caused by currents of air within the box which are not due to the tremors of the pier or ground. Many movements of the boom have been traced back to the changes in atmospheric moisture, pressure, and temperature even in the steady climate of England. In general, the air currents within the boxes and the movements in the superficial soil adjoining the building and the pressure of high winds against the walls of the observatory produce movements in the boom that are not due to seismic tremors. Every instrument has to be studied with reference to annual and diurnal changes in the meteorological influences. Professor Stupart states that at Toronto the seismograph was, from September, 1897, to December, 1898, placed on a heavy stone pier set 8 feet in the ground in a wooden frame outbuilding a few yards from the Astronomical Observatory.

In years gone by this pier had been used for magnetic observations; it was found, however, that the boom was much affected by air currents in calm radiation weather, and after trying many and various experiments to get rid of these, I decided to remove the instrument to the old magnetic cellar in the observatory which had been left vacant when the new magnetic observatory was built nine miles from Toronto; since the change we have had no trouble and our earth tremors are beautifully defined. In Victoria I placed the instrument on a cement pier built on the solid rock within a few yards of tide water, in the basement of an old Government building, and we have not been troubled with air currents at all.

The seismograph at Toronto was constructed by Robert W. Munro, Granville Works, Granville Place, Kings Cross Road, London, England, and cost $265 to which must be added about $35 for installation. If a suitable building had to be constructed the cost would of course be much greater.

Besides the disturbances produced by the atmosphere, this delicate horizontal pendulum frequently shows sudden jumps which in the observatory at Tokio were always toward the east for the first nine months, followed by three months of westerly motions, then three months of easterly, and then three months of erratic movements. Possibly, these all indicate a creeping of the soil for a long time in one direction and then in another. The total change during nearly two years was equivalent to a tip of the west side upward to the amount of seventeen seconds. Different forms of earthquake apparatus have been described by Milne, Gerland, and others, each of which records some special kind of movement, so that, in general, if instruments of several descriptions could be installed at the same locality, we might add to our records of earthquakes other forms of motion additional to those that are recorded by horizontal pendulums. Mr. C. G. Knott says that besides the daily and annual solar periods in earthquake frequency, there are daily, fortnightly, and monthly lunar periods, and in some cases, half daily periods. The idea is that the tidal stresses, due to the attraction of the moon for the solid earth, must produce these disturbances.

The first instrument of the Gray-Milne pattern was set up in 1883, at the central observatory in Tokio, where Prof. Thomas Gray, now of Terre Haute, and Prof. John Milne, now of Shide Hill House, Newport, on the Isle of Wight, were at that time associated together. This first seismograph still continues in use, and has recorded about 2,000 quakes, which are printed in full in the Reports of the British Association for the Advancement of Science.

In the report for 1897, Mr. Milne gives many details as to the construction and behavior of the apparatus at about ten stations and abstracts of the results. Among other things, he shows that many times the ocean cables are broken by earthquake shocks and not by anything inherent in the cable. The average number of breaks is about twenty-three per year for the 10,000 miles of cable that are at present in active use.

As a curious illustration of the possible value of a system of seismographic records, Milne alludes to the fact that in 1888 the two cables connecting Java and Australia were simultaneously broken and Australia cut off from the outside world for nineteen days; not knowing but that war had broken out, the military and naval reserves were called out to meet any possible contingency. In 1890 three cables were simultaneously broken and Australia was cut off for nine days. On both of these occasions a few seismographs would have sufficed to show the cause of the interruption and would have allayed the fear of war and the accompanying commercial paralysis. Milne's apparatus at Shide shows a record for every earthquake in Japan and the absence of record may be taken to mean the absence of an earthquake; thus, in September, 1896, when the English newspapers announced a great earthquake in Kobe, and those who had friends in Japan were filled with anxiety, Milne's record showed that no great earthquake could have occurred, and it was subsequently found that the cablegram was devoid of all foundation.

It is hoped that the accurate study of earthquakes will show whether the shocks go through the earth or around it, and thus give us some idea of the structure of the interior of our planet.

In the report of the British Association for the Advancement of Science for 1898, Professor Milne gives a list of twenty stations already supplied with his apparatus, and of ten or twelve more that have the matter under consideration. The work thus initiated by his committee is rapidly assuming the character of international cooperation, in which Great Britain and her colonies are taking the most prominent part.

On November 29, 1896, there was an extraordinary rainstorm on the island of Montserrat in the West Indies, which comes under the governor of the Leeward Islands; 20 inches of rain fell in the center of the island in about twelve hours, and since that time, it has been subject to constantly recurring slight shocks of earthquake, which come almost every day but do little harm. The rainstorm is supposed "to have set the earthquakes going," and the sulphur springs now emit much more gas than formerly. The sulphur springs and hot water springs are supposed to be connected with the crater of some extinct volcano. It is said that in 1880, there was a similar flood in the neighboring island of St. Kitts, and that simultaneously with that there occurred a volcanic disturbance in Dominica.

In order that records kept in all parts of the world may be compared and discussed, it is necessary that there should be some agreement as to the standard of time employed, and to this end a table showing the civil time employed at many places throughout the world is being prepared by Mr. Milne. The earthquake observatories and apparatus at six stations in Italy and Germany are described by him in the British report for 1898. A seismological institute is now established

at the University at Strasburg under the superintendence of Dr. G. Gerland.

The style of record given by the Milne seismograph is abundantly illustrated on Plates V and VI, which contains records of the following earthquakes:

1. January 24–25, 1899. This was the great earthquake at the City of Mexico. This severe shock was not appreciable to any of the Weather Bureau observers, but it made well-marked records on the seismographs at Toronto and Victoria. It reached Toronto at 23:50:24, Greenwich civil time, and attained its maximum at 0:19:55 of the 25th. The corresponding times for Victoria were 23:51:7 p. m. of the 24th and 0:2:54, Greenwich civil time, 25th. At the Isle of Wight the shock arrived at 0:24:42, Greenwich civil time, of the 25th, according to a letter from Mr. Stupart.

2. April 16. This disturbance began at Toronto 13:48:59, Greenwich civil time, April 16; maximum, 14:2:48; ended, 15:22:10. At Victoria the disturbance began at 13:42:30, Greenwich civil time, and ended at 15:33:42. This tremor was apparently of Japanese origin, according to Mr. Stupart.

3. June 5. Toronto: began June 5, 4:42:27, Greenwich civil time; maximum, 4:54:16; ended, 7:3:51. Victoria, began June 5, 4:48:10, Greenwich civil time; maximum, 5:9:0; end, 6:46:1. This tremor may have been of West Indian origin, according to Mr. Stupart; it occurred at the close of June 4, local reckoning, at Toronto and Victoria, but early on June 5, by Greenwich time.

4. June 5. Toronto: began, 15:7:54; maximum, 15:16:0; end, 17:17:?. Victoria: began, 15:13:1; maximum, 15:30:47; end, 16:12:43.

5. June 14. Toronto: began, 11:13:48; maximum, 11:23:0; ended, 13:18:57. Victoria: began, 11:17:25; maximum, 11:57:32; ended, 13:37:42.

THE WEATHER OF THE MONTH.

By ALFRED J. HENRY, Chief of Division of Records and Meteorological Data.

There was a very marked fall in pressure from April to May, 1899, over practically the whole of the United States, the monthly mean for the central and southern Rocky Mountains, the eastern foothills, and the plains being from .05 to .12 inch lower than during the preceding month. As the fall in pressure was greatest in the central Rocky Mountain region and least on the coasts, the chart of monthly distribution, No. IV, naturally shows a marked depression central in Colorado, with rather strong gradients in all directions, except to the southward. The chart of monthly pressure distribution is, in fact, an excellent type of certain winter lows that strike the continent about midway of the California coast and pass across the country from ocean to ocean. The weather of the month was not greatly unlike what is generally experienced with a similar distribution of pressure for a single day. To the northward of the region of lowest pressure it was cold, wet, and generally disagreeable. In the Gulf, South Atlantic, Middle Atlantic, and New England States warm and generally dry weather prevailed, while heavy rains were experienced in the panhandle of Texas, Oklahoma, and generally northeastward of Colorado. About the usual number of cloud bursts, destructive hailstorms, severe local storms, and tornadoes were reported. The electrical storms of the month were rather more numerous and violent than usual.

TEMPERATURE OF THE AIR.

The weather continued cool and unseasonable in the Northwest, this being the fourth consecutive month with temperature decidedly below normal. The greatest departure from normal conditions was in Montana, in which State there was an accumulated deficiency in temperature since January 1 of 1,184°, or an average of nearly 8° per day. The snowfall in Montana, western Wyoming, and eastern Idaho was unusually heavy, as may be seen by reference to Chart VIII. Minimum temperatures as low as 3° in Colorado and 7° in Montana were observed at single stations. The temperature was relatively low on the Pacific coast and generally throughout the Plateau region. Southward and eastward from central Colorado temperature was above normal, the regions of greatest excess being the Gulf States and the Ohio Valley and Tennessee.

In Canada.—Professor Stupart says:

The mean temperature of May was from 2° to 6° below average in Manitoba, the Northwest Territories and British Columbia, and a little above average in Ontario, Quebec, and the larger portion of the Maritime Provinces. Stations in southern Alberta show the greatest departure below, and those in central Ontario the greatest departure above average. The weather of the Northwest Territories was marked by two cold spells, the first of which occurred during the first few days of the month, when the temperature fell to 12° at Calgary, 10° at Edmonton, and 21° at Qu'Appelle; and the second during the 12th and few following days, when 14° was recorded at Calgary, 15° at Edmonton, and 21° at Prince Albert and Winnipeg. This latter cold spell spread rapidly eastward across the Dominion, and was pronounced in Ontario from the 14th up to about the 21st. The last heavy frost occurred in the Northwest and Manitoba about the 19th.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	10	54.1	+ 0.2	− 1.1	− 0.2
Middle Atlantic	12	62.4	+ 0.9	− 3.8	− 0.8
South Atlantic	10	72.4	+ 2.1	− 3.3	− 0.7
Florida Peninsula	7	78.5	+ 2.7	+ 0.4	+ 0.1
East Gulf	7	76.9	+ 4.3	− 6.7	− 1.3
West Gulf	7	76.5	+ 3.9	− 6.3	− 1.3
Ohio Valley and Tennessee	12	68.5	+ 3 4	− 5.7	− 1.1
Lower Lake	8	58.5	+ 1.7	+ 0.1	0.0
Upper Lake	9	53.5	+ 2.1	− 6.0	− 1.2
North Dakota	7	51.7	− 1.8	−17.5	− 3.5
Upper Mississippi	11	63.1	+ 1.6	−10.4	− 2.1
Missouri Valley	10	62.6	+ 2.1	−12.6	− 2.5
Northern Slope	7	50.9	− 2.5	−23.2	− 4.6
Middle Slope	6	64.7	+ 2.6	−11.0	− 2.2
Southern Slope	6	70.5	+ 1.8	+ 1.2	+ 0.2
Southern Plateau	13	62.4	− 4 5	− 3.4	− 0.7
Middle Plateau	9	51.7	− 5.0	− 8.7	− 1.7
Northern Plateau	10	49.7	− 5.9	− 9.8	− 2.0
North Pacific	9	49.5	− 4.7	− 8.6	− 1.7
Middle Pacific	5	54.9	− 3.5	− 1.3	− 0.3
South Pacific	4	58.6	− 3.8	− 1.7	− 0.3

PRECIPITATION.

The area over which rain was in excess of the normal is probably a little less than the area over which rainfall was below the normal amount. Considered by districts, the minus departures are greater than the positive departures as 2 to 1. The districts having the greatest negative departures are the east Gulf, 2.8 inches; Florida peninsula, 2.9; New England, 1.8. The districts having the greatest positive departures are upper Mississippi valley, 2.5; North Dakota, 1.1; southern Slope, 1.2; northern Slope, and north Pacific, 1.1, respectively.

On the whole the month should be classed as one of about

normal precipitation. The area of deficient rainfall includes the Gulf States, eastern Tennessee, and thence northeastward to and including New England, a region in which, by reason of the normal precipitation being slightly greater than is demanded by the needs of agriculture, minus departures have not the same value that they would have in regions of scanty precipitation.

Torrential rains fell in a number of places, swelling creeks and small streams to unusual proportions. Live stock, fences, and railroad tracks were the greatest sufferers.

In Canada.—Prof. R. F. Stupart says:

Throughout the Northwest Territories the precipitation was much in excess of the average for May, and this was particularly the case in southern Alberta, where it was several times greater than the average. Over the larger portions of Manitoba the rainfall was about average, some districts reporting a small excess, and others a small deficiency. A heavy snowfall, 20.00 inches at Qu'Appelle, and 9.00 inches at Prince Albert, occurred in Assiniboia and Saskatchewan between the 2d and the 4th, and a smaller quantity fell in many parts of the Territories and Manitoba between the 12th and 14th. In Ontario generally the rainfall was above average to a small amount, but locally, in the counties of Elgin, Lambton, and Bruce there was a deficiency. From the Ottawa Valley eastward, it was everywhere less than the average—at Montreal about one-half, and in the more eastern portions of Quebec even less than one-half the average. In the Maritime Provinces a deficiency was pretty general but not so pronounced as along the St. Lawrence.

The numerical values of total precipitation and total depth of snowfall are given in Tables I and II, and the geographic distribution is graphically shown on Charts III and VIII.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	10	1.82	50	−1.8	−0.2
Middle Atlantic	12	2.36	64	−1.3	−0.5
South Atlantic	10	2.44	60	−1.6	−0.8
Florida Peninsula	7	0.88	23	−2.9	+0.2
East Gulf	7	1.44	34	−2.8	−7.0
West Gulf	7	3.55	80	−0.9	−4.4
Ohio Valley and Tennessee	12	3.37	87	−0.5	−0.2
Lower Lake	8	3.92	115	+0.5	−0.6
Upper Lake	9	3.60	109	+0.3	−1.9
North Dakota	7	3.64	143	+1.1	−0.5
Upper Mississippi	11	6.62	161	+2.5	+1.2
Missouri Valley	10	4.53	105	+0.2	−1.9
Northern Slope	7	3.53	145	+1.1	+1.0
Middle Slope	6	3.72	106	+0.2	−1.6
Southern Slope	6	4.33	138	+1.2	−1.3
Southern Plateau	9	0.08	17	−0.4	−1.9
Middle Plateau	13	0.90	90	−0.1	+0.5
Northern Plateau	10	1.46	94	−0.1	−0.4
North Pacific	9	4.10	137	+1.1	+5.1
Middle Pacific	5	1.17	75	−0.4	−1.8
South Pacific	4	0.08	21	−0.3	−2.2

HAIL.

Some of the hailstorms of the month were very destructive. Those which visited portions of Illinois, Missouri, and Kentucky on the 7th and 8th were quite severe, and wrought serious damage to growing crops and vegetables, besides breaking many windows.

A heavy hailstorm swept over Cheyenne, Wyo., on the 19th.

The storms of the 21st and 22d were also very severe, especially in parts of Saline, Marion, Chase, Butler, Elk, and Chatauqua counties, Kans. In the counties named torrents of rain fell soon swelling the streams to overflowing, and drowning probably 1,000 head of live stock. Five hundred and ten cattle were drowned in one bunch in Butler County. The cattle went into a draw and were overcome by the flood of water and icy hail. Some of them when found were covered by drifts of hail, and chunks of ice to a depth of from 10 to 12 feet.

The following are the dates on which hail fell in the respective States:

Alabama, 12, 18, 21. Arkansas, 7, 9, 10, 11, 18, 22, 28, 29, 30, 31. California, 1, 4, 5, 14, 24. Colorado, 5, 6, 13, 16, 18, 19, 20, 22, 26, 27. Connecticut, 2. Delaware, 16. District of Columbia, 8, 16, 17, 18. Florida, 14, 15, 19. Georgia, 4, 5, 13, 14, 23. Idaho, 1, 2, 6, 8, 11, 12, 13, 16, 24, 25, 29, 30. Illinois, 1, 2, 3, 4, 7, 14, 16, 17, 21, 27, 28, 29, 30, 31. Indiana, 1, 4, 7, 8, 17, 28, 29, 31. Iowa, 2, 7, 14, 15, 16, 17, 21, 27, 28, 29, 30. Indian Territory, 28, 31. Kansas, 2, 4, 7, 9, 10, 11, 13, 17, 20, 22, 23, 24, 25, 26, 28, 29, 30, 31. Kentucky, 4, 6, 7, 8, 30, 31. Louisiana, 12, 23. Maryland, 2, 8, 9, 16. Massachusetts, 2. Michigan, 1, 13, 15, 16, 28, 29. Minnesota, 3, 9, 10, 15, 16, 21, 22, 26, 27, 30, 31. Mississippi, 7, 10, 12, 23. Missouri, 1, 3, 6, 7, 9, 10, 12, 14, 17, 18, 20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31. Montana, 2, 25, 26, 29. Nebraska, 2, 5, 9, 10, 13, 14, 15, 17, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 31. Nevada, 1, 6, 19, 26. New Jersey, 2, 11, 15, 23, 28. New York, 1, 2, 21, 22, 25, 28. North Carolina, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 18, 21, 22, 23, 24, 25, 26, 28, 29, 30. North Dakota, 15, 24, 25, 26, 30. Ohio, 1, 2, 8, 16, 17, 27, 28, 29, 30, 31. Oklahoma, 1, 28, 29, 31. Oregon, 1, 5, 8, 10, 11, 12, 13, 14, 16, 17, 18, 19, 23, 25. Pennsylvania, 2, 16, 28, 29. South Carolina, 6, 22, 30, 31. South Dakota, 2, 3, 9, 13, 14, 15, 20, 21, 25, 26, 27, 29, 30. Tennessee, 4, 6, 8, 10, 12, 21, 22, 28, 29, 30, 31. Texas, 5, 6, 7, 10, 11, 19, 21, 22, 23, 28. Utah, 7, 15, 19, 25, 27, 28. Virginia, 3, 4, 5, 8, 13, 16, 29, 31. Washington, 1, 11, 12, 13, 15, 17, 23, 24. West Virginia, 13. Wisconsin, 9, 15, 16, 17, 25, 26, 27, 29, 31. Wyoming, 6, 11, 15, 16, 19.

SLEET.

The following are the dates on which sleet fell in the respective States:

California, 1, 5, 7, 14, 18, 24, 25, 27. Idaho, 11, 29. Minnesota, 14. New Mexico, 2. North Dakota, 1, 2, 3, 4, 12, 15. Oregon, 1, 13. South Dakota, 3, 14, 21. Utah, 1, 2, 6, 16, 19, 20, 27. Washington, 13. Wyoming, 2.

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Amarillo, Tex	2	53	sw.	Mount Tamalpais, Cal.	18	60	nw.
Do	25	54	w.	Do	22	50	nw.
Buffalo, N. Y	29	55	sw.	Do	28	52	nw.
Chicago, Ill	1	50	sw.	Do	29	50	nw.
Do	26	53	s.	New York, N. Y	2	56	nw.
Do	28	56	s.	Northfield, Vt	1	50	sw.
Cleveland, Ohio	16	58	w.	Oklahoma, Okla	30	52	se.
Dodge, Kans	25	57	se.	Pierre, S. Dak	12	61	nw.
Hannibal, Mo	28	50	s.	Do	20	58	se.
Havre, Mont	11	63	nw.	Do	21	54	se.
Idaho Falls, Idaho	11	52	sw.	Do	30	53	w.
Lexington, Ky	12	50	nw.	Point Reyes Light, Cal.	1	59	nw.
Mount Tamalpais, Cal	1	55	nw.	Do	5	60	nw.
Do	2	66	nw.	Do	6	50	nw.
Do	3	60	nw.	Do	12	60	nw.
Do	4	50	nw.	Do	13	60	nw.
Do	5	59	nw.	Do	14	75	nw.
Do	6	50	nw.	Do	15	60	nw.
Do	11	60	n.	Do	18	54	nw.
Do	12	78	nw.	Do	19	54	nw.
Do	13	66	nw.	Do	20	54	nw.
Do	14	55	nw.	Salt Lake City, Utah	29	56	w.
Do	16	50	nw.	Williston, N. Dak	11	50	nw.
Do	17	66	nw.	Do	12	54	nw.

LOCAL STORMS AND TORNADOES.

A superficial reading of the various press dispatches in the

newspapers might easily convey the impression that tornadoes were unusually widespread and destructive. When the facts are ascertained, however, it does not appear that the storms were either especially frequent or violent. From the 1st to the 27th but one really violent tornado occurred. Beginning with the last-named date a stormy period set in, continuing intermittently until the end of the month.

Sixteen persons were killed by tornadoes during the month and about 34 injured, while the property loss was about $130,000. For the same time 104 persons were killed by lightning stroke and 88 injured.

Some of the more important details regarding the storms of the month are given below:

1st.—A severe local storm, probably a straight line gale, with small local whirls, destroyed some property at Wingate, Runnels County, Tex., moved from northwest to southeast.

6th.—A straight line gale from the northwest swept over portions of Oklahoma. The greatest violence was manifested at Chickasha where one person was injured and a number of frail buildings damaged.

8th.—A severe local storm occurred in Ballinger, Runnels County, Tex., on this date. No lives were lost; the damage was about $5,000.

9th.—A severe local storm passed through Coldwater, Comanche County, Kans., destroying about 20 building, mostly barns, and killing one person; moved from northwest to southeast; property loss about $10,000.

12th.—A number of severe local storms occurred in Tennessee, and a minor tornado was observed 8 miles northwest of Mount Sterling, Ky. A large tobacco barn was destroyed by the tornado, but little other damage was done. At 5 p. m., central time, on the same date, another tornado was observed 7 miles east of Mount Sterling. One person was killed, the limb of a tree striking him as he was driving near it. (Report of James O'Connell, voluntary observer).

16th.—A tornado formed about 2 miles north of Greely, in Delaware County, Iowa, and moved thence easterly and northeasterly, passing near the village of Colesburg. Nine buildings were totally destroyed and 18 badly damaged. Five persons were killed and 12 injured. The property loss was very heavy, probably $30,000. The path of great destruction was, on an average, 30 rods wide and 12½ miles long.

On the same date a straight line gale, with numerous local whirls, entered the State of Ohio at the northwestern corner, moving across the State with an average velocity of 50 miles per hour, and reappearing the following day in western Pennsylvania. Frail buildings, roofs, and chimneys suffer 1 by the violence of the wind, and the property loss by h. . and lightning was very great in some localities. In western Pennsylvania 5 persons were killed by lightning.

27th.—A period of severe local storms and tornadoes began on this date, continuing the next day; beginning again on the 30th, and continuing throughout the following day. As has been noted in these columns on previous occasions, tornadic activity frequently begins at a number of places along a north and south line and at nearly the same hour of local mean time. In this case three groups of tornadoes formed along the ninety-ninth meridian about 6 o'clock p. m., mean local time. The most northerly group had its origin in Brule County, S. Dak. The direction of movement was southward. Seven persons were killed within a distance of about 3 miles. Several buildings in the path of the storm were totally demolished, involving a loss to buildings and live stock together of about $8,000.

The second group, of which there were two distinct storms, formed in south-central Nebraska. The first storm was observed in Hamilton County, Nebr., the funnel cloud forming about 7 o'clock, central time. It moved northeastward in a path about 16 miles long, destroying many substantial residences in that distance. The coming of the storm was plainly visible and no lives were lost, although the property loss will probably aggregate $25,000.

A second storm was observed a little later in the day about 5 miles southwest of Minden, in Kearney County. It was not so severe as the one just mentioned; no lives were lost, and the property loss was small, probably not more than $2,500.

The third group also consisted of a pair of tornadoes, having their origin in Day and Woods counties, Okla., respectively. As in the case of the Nebraska tornadoes, the storm which formed first occurred farthest to the eastward, viz, in Woods County, between Augusta and Aline. It was viewed by a great many persons from a safe distance; its movement was very slow, being in full view about forty minutes. No casualties, and a small property loss, owing to the primative character of the buildings in that part of the country.

The second tornado crossed the Canadian River in the vicinity of Grand, the county seat of Day County. No casualties; property loss very small.

Severe local storms also occurred in Iowa, the one noted in Jackson County having the characteristics of a tornado. Property loss not large.

28th.—The severe storms of this date were confined mostly to Iowa. About 3:45 p. m. a tornado, of moderate violence only, passed through Jasper County, Iowa, causing a property loss of about $3,500. No casualties.

At 5:15 p. m., a small tornado passed through portions of Keokuk County, Iowa, injuring slightly six persons and destroying property to the amount of $2,000.

Another small tornado visited Johnson County, Iowa. Property loss about $2,000.

A straight line gale swept over portions of Wright County, Iowa, destroying a great number of buildings and injuring three persons. The property loss in this case was considerable, a low estimate placing it at $30,000.

29th.—A furious storm of wind, rain, and hail visited Buffalo, N. Y., at 3:40 p. m. The wind rose from almost calm to a velocity of 55 miles per hour in seven minutes. At 4:17 p. m. a sudden squall occurred during which the wind attained an estimated velocity of 80 miles per hour from the southwest. While the storm was at its height a squall struck and almost totally demolished the Buffalo Cast Iron Pipe Company's large brick building, 350 feet long by 75 feet wide and 45 feet high. The walls of the building were 14 inches thick, and braced with iron rods. Two men were severely injured and a large number had a very narrow escape from injury.

30th.—A small tornado passed through portions of Union County, S. Dak., on the evening of this date. No casualties; property loss about $4,000.

Dixon County, Nebr., was visited by a tornado about 6:00 p. m., central time, the storm moving across the county in a northeasterly direction in a path about 15 or 20 rods wide at the beginning, increasing to 40 rods later on. One person was injured and property valued at about $10,000 was destroyed. Several funnel clouds were observed.

A tornado formed about 10:00 p. m., near Corning, Holt County, Mo., moving thence northeasterly into Atchison County. The path of the storm was from 100 feet to ¼ mile wide and 10 miles long. One person was killed and one severely injured.

Two groups of tornadoes formed on the western border of Iowa between 7:00 and 8:00 p. m., central time. The first one, in point of time, was observed south of Kingsley, Plymouth County. Owing to its being plainly visible there was no loss of life, although farm property valued at $7,000 was destroyed. The second manifestation of tornadic force in the line of the first group was observed in Pocahontas County,

to the eastward of Plymouth County, at 9:15 p. m. Four persons were injured and property valued at $5,000 was destroyed.

The second group of tornadoes was first observed in Mills County, about 100 miles south of Plymouth County. One person was killed near Mineola, and eight others injured. Property loss, about $3,000. A tornado was next observed to the northeastward in Cass and Adair Counties, at 10:30 p. m. Six persons were injured and the property loss was about $5,000.

Severe local storms occurred at various other points in Iowa, the stormy conditions drifting eastward and dying out in Illinois, about 3 a. m. of the following day.

HUMIDITY.

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	74	− 4	Missouri Valley	70	+ 5
Middle Atlantic	71	0	Northern Slope	61	+ 4
South Atlantic	75	+ 1	Middle Slope	57	− 3
Florida Peninsula	75	− 2	Southern Slope	62	+ 4
East Gulf	72	0	Southern Plateau	20	−10
West Gulf	79	+ 6	Middle Plateau	42	− 3
Ohio Valley and Tennessee	69	+ 1	Northern Plateau	60	+ 2
Lower Lake	69	− 1	North Pacific Coast	79	+ 1
Upper Lake	75	+ 3	Middle Pacific Coast	66	− 6
North Dakota	67	+ 3	South Pacific Coast	69	+ 1
Upper Mississippi	70	+ 3			

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table VII, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 5,305 thunderstorms were received during the current month as against 2,871 in 1898 and 1,962 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country were most numerous were: 29th, 411; 28th, 311; 31st, 309; 2d, 295.

Reports were most numerous from: Illinois, 382; Ohio, 377; Missouri, 322; Iowa, 289; Michigan, 285.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, 20th to 28th.

The greatest number of reports were received for the following dates: 3d, 42; 4th, 21; 1st, 18; 15th, 13.

Reports were most numerous from: Washington, 11; Minnesota, 10; New Hampshire, South Dakota, Wisconsin, 8.

In Canada.—Auroras were reported as follows: Yarmouth, 15th; Father Point, 3d, 4th, 5th, 7th, 11th, 15th; Quebec, 3d, 4th, 5th, 7th, 15th; Montreal, 3d, 4th, 15th; Toronto, 3d; Kingston, 4th, 11th, 15th; Port Stanley, 3d; Minnedosa, 12th, 13th; Medicine Hat, 3d, 4th, 5th; Swift Current, 4th; Banff, 3d; Prince Albert, 1st, 5th; Battleford, 5th.

Thunderstorms were reported as follows: Halifax, 1st, 3d; Chatham, 26th; Quebec, 2d, 26th, 30th; Montreal, 2d; Toronto, 1st, 16th, 28th, 29th; White River, 1st, 31st; Kingston, 1st; Port Stanley, 11th, 16th, 17th, 27th, 29th, 31st; Saugeen, 11th, 28th, 29th; Parry Sound, 1st, 29th; Port Arthur, 17th; Winnipeg, 26th; Ottawa, 26th, 30th; Qu'Appelle, 26th; Medicine Hat, 9th, 25th, 26th; Swift Current, 25th, 27th; Calgary, 24th.

SUNSHINE AND CLOUDINESS.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographical districts, appear in Table I.

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.4	−0.1	Missouri Valley	6.1	+0.7
Middle Atlantic	5.3	+0.1	Northern Slope	6.0	+0.6
South Atlantic	4.4	0.0	Middle Slope	4.4	−0.4
Florida Peninsula	3.5	−1.0	Southern Slope	4.2	−0.3
East Gulf	3.4	−0.9	Southern Plateau	2.9	+0.7
West Gulf	6.0	+1.1	Middle Plateau	5.9	+1.8
Ohio Valley and Tennessee	5.8	+0.7	Northern Plateau	6.1	+0.5
Lower Lake	5.8	+0.6	North Pacific Coast	7.9	+2.0
Upper Lake	5.6	+0.1	Middle Pacific Coast	4.0	−0.2
North Dakota	6.0	+0.7	South Pacific Coast	3.5	−0.7
Upper Mississippi	6.1	+0.9			

DESCRIPTION OF TABLES AND CHARTS.

By ALFRED J. HENRY, Chief of Division of Records and Meteorological Data.

For text descriptive of tables and charts see page 164 of REVIEW for April, 1899.

TABLE I.—*Climatological data for Weather Bureau Stations, May, 1899.*

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Mean actual, 8 a. m. and 8 p. m. ÷ 2.	Pressure, in inches: Mean reduced.	Pressure, in inches: Departure from normal.	Temperature of the air, in degrees Fahrenheit: Mean max. and min. ÷ 2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Date.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Date.	Temperature: Mean minimum.	Temperature: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
New England.							54.1	+ 0.2										74	1.82	− 1.8										5.4	
Eastport	76	69	74	29.92	30.01	+ .05	48.6	+ 1.1	80	31	56	35	4	41	34	44	40	79	3.92	+ 0.2	11	7,372	ne.	36	ne.	3	7	13	11	6.2	
Portland, Me.	103	81	89	29.88	29.98	+ .01	54.1	+ 0.5	84	31	63	36	4	46	36	48	42	67	0.73	− 2.9	8	5,972	s.	30	nw.	12	14	6	11	5.2	
Northfield	872	15	65	29.08	30.02	+ .05	52.6	− 1.1	81	1	65	26	4	40	42	49	43	70	1.52	− 1.6	11	6,735	s.	50	sw.	1	9	9	13	6.0	
Boston	125	115	181	29.90	30.04	+ .07	57.8	+ 1.3	89	1	66	41	4	49	32	50	43	63	0.81	− 2.8	10	7,744	sw.	33	ne.	3	14	10	7	4.6	
Nantucket	14	43	54	30.03	30.04	+ .07	52.7	+ 0.2	75	31	58	40	4	47	22	48	45	80	0.77	− 2.7	9	8,356	sw.	44	ne.	3	10	8	13	6.1	
Woods Hole	22	11	57	30.02	30.04	+ .05	53.6	+ 0.1	74	31	60	39	4	48	20	50	47	83	1.58	− 1.8	9	9,773	sw.	36	sw.	30	13	9	9	5.1	
Vineyard Haven	......	20	55	......	......	......	56.0	− 1.1	82	31	64	36	4	48	24	....	....	....	1.73	− 1.7	10	6,430	sw.	36	ne.	3	7	11	13	6.2	
Block Island	27	11	48	30.01	30.04	+ .05	52.8	+ 0.4	74	31	59	38	4	47	19	49	45	79	2.09	− 1.7	10	9,445	sw.	45	ne.	3	14	9	8	4.3	
Narragansett	......	10	...	......	......	......	54.4	− 0.2	77	31	62	34	6	46	29	....	....	....	2.57	− 1.5	10	......	sw.	....	......	...	20	3	8	...	
New Haven	107	118	140	29.92	30.04	+ .05	58.4	+ 0.8	83	2	68	38	4	49	30	52	46	67	2.52	− 1.1	10	6,048	sw.	30	ne.	3	14	11	6	4.6	
Mid. Atlan. States.							62.4	+ 0.9										71	2.36	− 1.3										5.3	
Albany	97	84	113	29.93	30.04	+ .07	59.8	+ 0.5	86	2	70	40	15	50	31	54	49	71	2.23	− 1.0	11	5,638	s.	35	n.	3	13	8	10	5.0	
Binghamton	875	79	90	......	......	......	58.0	+ 1.2	88	1	69	34	5	47	38	....	....	....	2.43	− 1.7	13	4,141	nw.	26	nw.	1	7	12	12	6.0	
New York	314	313	346	29.71	30.04	+ .05	61.0	+ 1.5	84	28	69	46	4	53	27	53	48	67	1.14	− 2.0	8	9,058	nw.	56	nw.	2	10	14	7	5.2	
Harrisburg	377	94	104	......	......	......	63.0	+ 2.8	87	28	72	47	4	54	28	....	....	....	4.49	− 0.2	12	4,518	sw.	35	w.	29	7	10	14	6.2	
Philadelphia	117	168	184	29.93	30.05	+ .04	63.2	+ 1.2	89	28	73	45	4	54	27	56	50	66	2.30	− 0.9	11	6,954	sw.	36	n.	2	8	11	12	5.6	
Atlantic City	52	68	76	30.00	30.05	+ .06	57.8	+ 0.6	81	31	64	42	4	52	27	54	51	80	1.20	− 1.6	5	7,359	sw.	32	nw.	14	8	18	5	5.1	
Cape May	24	52	70	30.05	30.07	......	58.2	− 0.4	76	12	64	42	4	53	28	54	....	....	1.80	− 0.9	11	8,981	s.	40	ne.	3	10	17	4	4.8	
Baltimore	123	68	82	29.92	30.05	+ .05	64.5	+ 0.3	90	28	74	47	4	55	28	57	51	65	3.29	− 0.5	13	3,650	se.	30	nw.	16	12	9	10	5.5	
Washington	112	59	76	29.94	30.06	+ .05	64.4	+ 0.5	90	29	75	42	26	54	33	58	53	70	2.53	− 1.4	14	4,350	s.	36	sw.	29	14	9	8	4.5	
Cape Henry	......	5	34	......	......	......	65.0	+ 0.5	92	28	72	49	5	58	35	....	....	....	2.22	− 1.8	11	9,384	se.	42	n.	14	13	8	10	5.2	
Lynchburg	685	83	88	29.32	30.05	+ .06	67.6	+ 1.6	90	17	78	44	25	57	35	59	55	69	2.99	− 0.9	13	2,453	ne.	26	nw.	18	12	11	8	5.2	
Norfolk	92	102	111	29.97	30.07	+ .07	66.4	0.0	90	31	76	48	5	57	30	60	57	78	1.69	− 2.6	12	6,531	s.	30	ne.	3	14	9	8	4.6	
Richmond	144	98	105	......	......	......	67.6	......	91	16	78	47	25	57	32	....	....	....	2.14	......	13	4,651	n.	28	w.	29	9	8	14	6.2	
S. Atlantic States.							72.4	+ 2.1										75	2.44	− 1.6										4.4	
Charlotte	773	68	76	29.24	30.04	+ .05	71.0	+ 2.6	92	16	82	47	25	60	32	61	55	64	2.28	− 2.1	9	4,536	ne.	47	sw.	17	5	16	10	6.0	
Hatteras	11	17	86	30.05	30.06	+ .06	66.8	+ 0.4	82	17	72	54	15	62	19	62	60	83	2.55	− 2.0	13	9,076	ne.	42	n.	14	17	10	4	4.1	
Kittyhawk	9	12	30	......	......	......	65.2	− 0.8	87	31	72	52	*	58	25	....	....	....	1.70	− 2.0	7	10,072	......	....	....	...	17	7	7	4.7	
Raleigh	375	93	101	29.67	30.06	+ .07	69.3	+ 1.8	92	3	79	45	25	59	31	62	60	77	4.78	− 0.9	10	3,920	sw.	27	n.	3	12	14	5	4.5	
Wilmington	78	82	90	29.99	30.07	+ .08	70.2	+ 0.5	92	18	79	50	25	62	28	64	62	80	4.12	0.0	11	5,832	sw.	44	ne.	3	14	11	6	4.5	
Charleston	48	14	92	30.04	30.09	+ .09	75.3	+ 2.9	98	18	82	58	24	69	23	68	65	75	3.31	− 0.7	8	8,384	s.	34	nw.	22	10	19	2	4.1	
Columbia	......	5	...	......	......	......	75.6	+ 3.6	99	17	88	50	25	63	33	....	....	....	0.65	− 3.2	6	......	sw.	....	......	...	12	9	10	4.9	
Augusta	180	89	108	29.86	30.04	+ .07	75.5	+ 3.5	96	17	87	52	26	64	33	65	60	64	2.02	− 1.4	4	4,697	se.	36	nw.	18	17	11	3	3.6	
Savannah	82	63	89	29.97	30.05	+ .04	76.4	+ 3.5	97	18	86	58	24	67	29	68	65	75	1.11	− 1.8	8	6,374	s.	42	nw.	13	17	11	3	3.6	
Jacksonville	43	60	84	30.01	30.06	+ .08	78.3	+ 3.4	96	18	88	61	3	68	32	71	69	81	1.86	− 2.1	7	5,618	w.	48	w.	13	16	13	2	4.1	
Florida Peninsula.							78.4	+ 1.4										75	0.92	− 3.0										3.5	
Jupiter	28	13	30	30.01	30.04	+ .07	77.8	+ 2.1	92	9	84	65	24	71	25	71	68	76	1.65	− 4.2	7	6,766	ne.	39	w.	24	26	5	0	2.4	
Key West	22	43	50	30.02	30.04	+ .08	79.8	+ 0.4	88	22	84	68	1	76	13	73	70	74	0.64	− 2.5	5	5,409	e.	24	ne.	1	16	15	0	3.5	
Tampa	36	60	67	30.01	30.05	+ .07	77.7	+ 1.7	91	18	87	64	3	68	25	70	67	75	0.48	− 2.4	4	4,890	w.	21	w.	18	9	21	1	4.7	
East Gulf States.							76.9	+ 4.3										72	1.44	− 2.8										3.4	
Atlanta	1,131	92	126	28.89	30.06	+ .04	74.4	+ 5.6	91	16	84	54	25	65	27	66	61	69	1.21	− 2.0	8	5,867	sw.	35	w.	7	12	18	1	3.9	
Macon	......	...	...	......	......	......	75.0	......	95	*	87	53	26	63	34	....	....	....	1.83	......	10	4,231	s.	40	nw.	7	9	22	0	3.8	
Pensacola	56	78	90	......	......	......	77.3	+ 3.8	87	9	83	65	25	72	20	....	....	....	2.00	− 1.3	4	7,220	sw.	33	nw.	23	22	8	1	3.3	
Mobile	57	88	96	29.98	30.04	+ .07	76.6	+ 3.0	91	8	84	69	1	70	21	72	70	81	1.00	− 3.3	3	5,794	s.	22	sw.	7	28	3	0	2.0	
Montgomery	221	100	112	29.80	30.03	+ .04	78.0	+ 5.2	94	16	89	55	25	67	31	67	62	64	1.73	− 2.3	4	4,648	s.	36	sw.	23	18	8	5	3.5	
Meridian	375	84	94	......	......	......	75.8	+ 5.4	92	15	87	56	25	65	32	....	....	....	3.72	− 2.2	6	3,806	sw.	34	se.	29	18	12	1	3.6	
Vicksburg	247	65	73	29.72	29.98	+ .01	76.8	+ 4.2	91	15	86	61	25	68	24	69	66	73	1.04	− 3.9	3	4,811	sw.	41	nw.	23	13	17	1	3.8	
New Orleans	54	112	120	29.98	30.04	+ .09	78.8	+ 4.2	90	19	86	65	1	72	17	71	68	74	0.14	− 4.8	1	5,682	s.	26	sw.	12	14	17	0	3.5	
Port Eads	......	27	...	......	......	......	77.5	+ 2.9	86	18	82	67	5	73	14	....	....	....	0.67	− 2.6	3	......	sw.	....	......	...	9	13	9	....	
West Gulf States.							76.5	+ 3.9										79	3.55	− 0.9										6.0	
Shreveport	249	77	84	29.70	29.96	+ .01	77.3	+ 4.2	93	29	87	61	24	68	25	69	65	71	2.61	− 1.6	6	5,146	se.	25	s.	12	8	3	20	6.5	
Fort Smith	461	63	72	29.41	29.91	.00	73.7	+ 5.5	90	15	82	57	24	65	24	67	64	76	8.38	+ 3.6	17	5,351	e.	32	sw.	7	3	14	14	6.8	
Little Rock	357	93	100	29.61	29.98	+ .03	73.1	+ 3.8	90	15	81	56	24	65	25	67	64	78	5.66	− 0.1	8	5,477	s.	36	nw.	28	6	16	9	5.6	
Corpus Christi	20	42	50	29.89	29.91	− .02	78.0	+ 2.6	86	12	81	66	11	75	12	75	74	88	1.16	− 2.1	2	13,496	se.	36	se.	11	0	21	10	6.1	
Fort Worth	670	106	114	......	......	......	75.4	......	93	29	85	53	4	66	30	....	....	....	2.01	......	9	8,659	s.	36	sw.	23	3	27	1	4.8	
Galveston	54	85	96	29.90	29.95	+ .01	78.2	+ 2.4	85	25	81	71	1	76	8	74	72	86	T.	− 3.8	0	8,190	se.	26	se.	11	4	16	11	6.1	
Palestine	510	54	61	29.40	29.93	− .02	76.6	+ 5.3	91	29	85	63	*	68	25	70	68	79	4.84	− 1.0	6	5,961	s.	28	s.	2	4	15	12	6.5	
San Antonio	704	95	104	29.17	29.89	− .02	78.4	+ 3.5	95	12	86	62	11	71	29	70	67	75	2.22	− 1.0	6	8,691	se.	39	se.	11	8	13	10	5.8	
Ohio Val. & Tenn.							68.5	+ 3.4										69	3.37	− 0.5										5.8	
Chattanooga	762	106	112	29.26	30.05	+ .06	73.2	+ 5.5	92	15	84	56	20	63	31	63	58	65	1.73	− 2.2	10	4,706	s.	37	w.	12	7	20	4	5.1	
Knoxville	1,004	10	88	29.02	30.07	+ .06	70.6	+ 4.4	90	16	81	51	29	60	32	62	58	70	3.58	− 0.3	14	4,890	sw.	38	w.	12	5	19	7	5.6	
Memphis	399	140	154	29.59	30.01	+ .05	73.7	+ 3.5	90	15	81	58	24	66	25	66	62	72	5.18	+ 0.7	10	6,988	sw.	42	w.	12	6	14	11	5.9	
Nashville	545	128	134	29.46	30.03	+ .06	72.4	+ 4.1	90	31	82	55	14	63	32	64	60	71	3.36	− 0.2	10	4,690	sw.	30	nw.	12	5	15	11	5.7	
Lexington	990	75	102	......	......	......	66.7	+ 3.1	87	16	75	46	23	59	27	....	....	....	3.63	+ 0.1	16	6,412	sw.	50	nw.	12	8	12	11	5.5	
Louisville	525	114	136	29.46	30.03	+ .06	69.0	+ 2.9	90	16	78	49	23	60	30	61	56	69	3.17	− 0.6	14	5,937	s.	31	sw.	30	9	6	16	6.1	
Evansville	434	72	82	......	......	......	68.8	......	87	15	77	50	23	61	29	....	....	....	5.40	......	13	5,793	s.	35	s.	12	12	12	7	4.7	
Indianapolis	823	154	164	29.15	30.02	+ .04	64.2	+ 1.0	87	16	72	45	23	56	27	58	51	70	3.38	− 0.8	16	7,239	s.	40	sw.	16	4	15	12	6.5	
Cincinnati	628	152	157	29.37	30.03	+ .06	66.9	+ 2.2	89	16	75	47	23	59	26	59	54	66	4.33	+ 0.9	11	5,383	se.	31	nw.	4	10	12	9	5.5	
Columbus	824	87	100	29.16	30.03	+ .06	65.4	+ 3.4	88	16	75	45	14	56	32	57	52	70	2.25	− 2.0	14	5,694	sw.	27	w.	16	6	19	6	5.5	
Pittsburg	842	116	123	29.14	30.08	+ .04	65.0	+ 2.8	86	16	74	42	21	56	32	57	52	67	3.26	− 0.2	11	3,962	sw.	35	nw.	29	9	13	9	5.3	
Parkersburg	638	77	84	29.38	30.06	+ .08	66.4	+ 4.9	89	16	77	44	20	56	37	59	55	71	3.17	− 0.8	9	3,656	ne.	36	nw.	31	5	13	13	6.4	
Elkins	1,940	41	51	......	......	......	60.4	......	84	16	73	37	25	48	41	....	....	....	6.12	......	15	3,237	w.	30	ne.	3	3	13	15	7.0	
Lower Lake Region.							58.5	+ 1.7										69	3.92	+ 0.5										5.8	
Buffalo	768	178	206	29.20	30.02	+ .05	56.2	+ 2.2	83	23	64	40	14	49	29	50	44	67	3.22	− 0.2	11	8,865	sw.	55	sw.	29	7	12	12	6.3	
Oswego	335	76	87	29.65	30.02	+ .03	54.0	0.0	81	1	62	37	15	46	25	49	44	69	3.63	+ 0.8	14	6,054	w.	26	se.	18	10	12	9	5.2	
Rochester	523	81	90	29.46	30.03	+ .06	57.8	+ 1.5	86	1	67	36	15	48	33	50	45	66	2.81	− 0.5	16	5,282	sw.	28	w.	1	15	9	7	4.7	
Erie	714	92	102	29.28	30.04	+ .07	57.4	+ 0.7	82	29	66	40	16	49	34	53	49	74	5.35	+ 1.5	12	6,889	ne.	30	sw.	29	8	9	14	6.2	
Cleveland	762	190	201	29.21	30.02	+ .03	60.0	+ 2.3	84	1	67	45	19	53	33	55	50	72	3.11	− 0.5	14	9,589	n.	58	w.	16	5	17	9	5.7	
Sandusky	629	62	74	29.35	30.02	+ .03	61.4	+ 2.9	86	16	69	46	19	54	36	55	51	71	4.32	+ 0.8	14	6,192	ne.	40	nw.	16	6	7	18	6.8	
Toledo	628	123	127	29.35	30.02	+ .05	61.4	+ 2.0	84	1	70	40	22	53	31	55	50	70	5.55	+ 2.2	18	7,190	ne.	44	nw.	16	10	12	9	5.3	
Detroit	730	160	166	29.24	30.02	+ .04	59.8	+ 2.3	84	1	68	39	22	52	24	53	47	66	3.38	− 0.1	12	6,949	sw.	33	sw.	27	7	15	9	6.0	
Upper Lake Region.							53.5	+ 2.1										75	3.60	+ 0.3										5.6	
Alpena	609	61	65	29.36	30.02	+ .05	52.2	+ 3.2	84	1	61	30	15	43	40	48	44	76	2.55	− 0.9	12	7,452	se.	39	sw.	1	12	10	9	5.2	
Escanaba	612	43	57	29.34	30.00	+ .04	50.4	+ 1.1	81	31	59	30	15	42	29	47	44	80	4.05	+ 0.7	12	7,171	se.	32	s.	1	9	15	7	5.1	
Grand Haven	628	55	64	29.31	29.99	+ .04	56.8	+ 2.4	77	3	67	38	21	47	29	51	46	71	4.09	+ 0.7	11	7,101	sw.	40	sw.	29	8	15	8	5.2	
Marquette	734	67	95	29.18	29.98	.00	50.4	+ 1.4	84	12	59	30	14	42	32	45	40	75	4.74	+ 1.8	14	7,022	nw.	41	s.	12	6	9	16	6.6	
Port Huron	639	70	108	29.35	30.04	+ .07	56.4	+ 3.2	83	1	66	38	14	47	33	51	47	75	2.14	− 1.2	14	7,667	n.	34	ne.	13	8	13	10	5.4	
Sault Ste. Marie	624	58	65	29.33	30.00	+ .06	50.9	+ 3.1	76	31	61	30	15	40	35	46	43	80	4.09	+ 1.9	14	7,793	e.	44	nw.	13	9	12	10	5.7	1.0
Chicago	824	241	274	29.14	30.01	+ .05	59.0	+ 2.9	83	1	67	42	15	51	38	53	48	73	4.35	+ 0.6	15	12,819	ne.	56	s.	28	8	15	8	5.1	
Milwaukee	681	124	142	29.28	30.01	+ .04	55.8	+ 2.9	80	31	65	40	14	46	32	49	44	69	3.42	− 0.1	14	8,059	ne.	43	sw.	1	8	5	18	6.6	
Green Bay	617	49	57	29.32	29.98	.00	56.3	+ 2.4	80	12	66	37	20	47	32	50	46	71	1.95	− 1.9	13	6,588	ne.	31	sw.	31	11	8	12	5.6	
Duluth	702	95	106	29.21	29.98	+ .02	46.6	− 1.4	72	30	54	33	14	39	31	42	38	76	4.66	+ 1.0	13	8,787	ne.	38	ne.	26	8	12	11	6.0	
North Dakota.							51.7	− 1.8										67	3.65	+ 1.3										6.0	
Moorhead	935	54	60	28.91	29.92	− .01	53.6	+ 0.4	83	9	64	26	13	43	40	47	40	66	4.30	+ 1.8	12	8,682	se.	45	ne.	30	6	8	17	6.8	
Bismarck	1,674	16	29	28.13	29.90	+ .01	52.3	− 1.9	84	11	62	27	13	43	36	46	41	69	4.27	+ 1.8	16	9,181	e.	48	w.	3	8	14	9	5.7	0.2
Williston	1,872	15	31	27.91	29.90	+ .01	49.2	− 4.0	75	24	60	18	13	38	43	43	37	67	2.39	+ 0.3	10	10,674	se.	54	nw.	12	13	9	9	5.4	5.4

TABLE I.—*Climatological data for Weather Bureau Stations, May, 1899*—Continued.

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Mean actual, 8 a. m. and 8 p. m. ÷ 2.	Pressure, in inches: Mean reduced.	Pressure, in inches: Departure from normal.	Temperature of the air, in degrees Fahrenheit: Mean max. and min. ÷ 2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Date.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Date.	Temperature: Mean minimum.	Temperature: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
Upper Miss. Valley.							63.1	+ 1.6										70	6.62	+ 2.5										6.1	
Minneapolis	......	99	208	......	......	......	58.2	+ 1.4	83	26	68	36	13	48	31	....	....	....	3.36	— 0.4	12	9,957	s.	42	se.	15	4	14	13	....	
St. Paul	837	114	124	29.02	29.92	— .01	58.2	+ 0.7	82	26	68	37	13	49	31	50	43	62	3.50	+ 0.1	13	6,665	se.	33	nw.	31	6	16	9	5.8	
La Crosse	720	70	78	......	......	......	59.6	+ 0.2	83	11	69	40	13	50	34	....	....	....	4.58	+ 1.3	13	5,779	se.	36	sw.	25	8	8	15	6.4	
Davenport	606	71	79	29.31	29.96	.00	62.5	+ 1.8	83	16	72	42	13	53	29	56	51	69	7.35	+ 3.0	14	6,710	ne.	36	ne.	14	8	8	15	6.4	
Des Moines	867	84	88	29.03	29.95	+ .02	61.0	+ 0.6	84	15	70	41	4	52	38	54	49	69	6.71	+ 2.0	16	7,557	se.	37	sw.	1	7	11	13	6.3	
Dubuque	698	101	109	29.22	29.97	+ .02	60.8	+ 0.9	82	12	70	42	13	51	30	53	47	64	5.75	+ 1.8	16	6,410	s.	34	nw.	10	8	14	9	5.3	
Keokuk	614	64	78	29.32	29.96	+ .02	64.0	+ 1.4	86	16	73	43	*	55	37	58	54	73	11.47	+ 7.4	16	6,045	sw.	36	sw.	3	8	13	10	5.6	
Cairo	359	87	93	29.62	30.00	+ .06	70.4	+ 3.3	88	15	78	55	14	63	24	64	61	75	5.27	+ 1.4	12	6,432	s.	36	nw.	21	5	14	12	6.1	
Springfield, Ill	644	82	92	29.30	29.98	+ .01	64.6	+ 2.2	87	16	74	44	20	55	33	59	55	77	11.81	+ 6.8	16	7,109	s.	27	s.	31	4	10	17	6.9	
Hannibal	534	75	107	......	......	......	65.8	+ 2.7	87	15	75	45	20	57	32	....	....	....	6.75	+ 2.0	17	7,187	s.	50	s.	28	6	18	7	5.3	
St. Louis	567	111	210	29.38	29.98	+ .04	68.7	+ 2.9	90	16	77	48	20	60	26	61	57	71	6.32	+ 1.7	15	6,666	s.	48	sw.	28	4	13	14	6.9	
Missouri Valley.							62.6	+ 2.1										70	4.53	+ 0.2										6.1	
Columbia	783	4	84	......	......	......	66.6	+ 2.5	89	15	78	41	4	56	32	....	....	....	4.89	— 1.0	17	6,297	s.	37	nw.	31	5	14	12	6.6	
Kansas City	963	78	95	28.91	29.92	.00	67.6	+ 3.4	86	14	77	49	13	59	30	59	54	68	5.10	+ 0.5	10	7,141	se.	32	nw.	10	7	12	12	5.8	
Springfield, Mo	1,324	100	108	28.56	29.94	.00	68.0	+ 4.8	86	15	76	51	4	60	26	62	59	78	6.72	+ 0.6	16	8,454	s.	37	nw.	28	10	13	8	5.2	
Topeka	......	81	....	......	......	......	67.8	+ 4.4	90	14	78	44	4	57	35	....	....	....	4.28	— 1.2	12	......	s.	....	......	...	7	19	5	5.4	
Lincoln	1,199	74	84	28.61	29.87	— .06	62.2	+ 1.1	89	30	72	41	1	52	36	55	50	69	2.29	— 2.0	13	9,091	se.	40	sw.	27	7	12	12	5.7	
Omaha	1,105	115	123	28.73	29.89	— .03	62.3	+ 0.6	87	15	71	44	14	54	39	56	52	74	4.45	+ 0.1	14	7,191	se.	32	sw.	26	4	15	12	6.4	
Sioux City	1,139	96	164	......	......	......	59.4	+ 1.0	88	11	70	34	13	49	43	....	....	....	6.18	+ 2.8	16	11,474	e.	47	nw.	28	5	9	17	6.7	
Pierre	1,572	50	62	28.21	29.88	— .01	56.4	+ 0.8	90	11	66	34	3	46	38	48	41	63	4.15	+ 1.8	12	12,288	se.	61	nw.	12	8	9	14	6.5	
Huron	1,306	56	67	28.50	29.90	— .03	56.6	+ 1.5	89	11	68	28	13	46	39	50	44	68	2.96	0.0	12	10,577	e.	49	e.	20	10	10	11	5.8	
Yankton	1,234	52	58	......	......	......	59.4	+ 0.9	89	11	70	35	4	49	34	....	....	....	4.24	— 0.1	20	8,657	e.	43	s.	11	6	11	14	6.5	
Northern Slope.							50.9	— 2.5										61	3.53	+ 1.1										6.0	
Havre	2,494	46	47	27.24	29.87	— .04	46.4	— 6.9	77	25	56	15	3	37	33	42	37	73	5.68	+ 4.1	13	9,429	e.	63	nw.	11	7	15	9	6.0	33.4
Miles City	2,372	41	49	27.35	29.84	— .07	53.1	— 3.3	80	*	64	25	3	43	36	46	40	68	2.84	+ 0.6	9	6,549	e.	42	e.	14	10	13	8	5.2	4.6
Helena	4,108	88	93	25.75	29.97	+ .04	47.2	— 4.6	76	24	56	24	1	38	30	37	27	53	1.98	+ 0.4	12	6,668	sw.	38	sw.	26	5	15	11	6.4	1.0
Kalispell	2,964	45	51	26.83	29.93	......	47.6	......	78	24	58	17	1	37	33	41	35	67	2.11	......	11	......	....	....	......	...	2	12	17	7.1	5.2
Rapid City	3,251	46	50	26.48	29.83	— .09	53.2	+ 0.3	86	11	64	30	3	43	38	45	38	64	6.76	+ 3.2	13	6,860	w.	42	nw.	11	9	12	10	5.5	....
Cheyenne	6,084	58	60	23.90	29.87	— .03	49.4	— 1.2	76	24	63	24	3	36	41	40	27	49	1.70	— 0.6	10	9,130	s.	48	s.	19	5	14	12	6.3	0.6
Lander	5,372	28	36	24.52	29.89	— .02	48.6	— 1.6	76	11	62	17	3	35	40	38	24	47	2.15	— 0.6	6	4,171	sw.	38	sw.	1	3	21	7	6.0	3.0
North Platte	2,826	43	52	26.96	29.88	— .02	58.2	0.0	85	11	70	32	4	47	37	51	45	68	3.58	+ 0.9	14	8,434	se.	42	nw.	27	10	15	6	5.4	....
Middle Slope.							64.7	+ 2.6										57	3.72	+ 0.2										4.4	
Denver	5,290	79	151	24.60	29.85	— .05	56.8	+ 0.4	83	13	71	29	4	42	43	43	25	40	0.15	— 2.7	5	6,408	s.	42	w.	20	12	17	2	4.1	T.
Pueblo	4,682	74	81	25.15	29.80	— .06	59.4	+ 0.7	89	14	76	28	3	43	49	44	24	33	T.	— 1.8	0	6,659	nw.	36	w.	25	16	15	0	3.8	
Concordia	1,398	42	47	28.40	29.86	— .07	66.3	+ 4.2	95	*	78	39	4	54	41	57	50	64	5.34	+ 1.1	13	6,861	s.	32	s.	2	9	12	10	5.2	
Dodge	2,504	44	59	27.27	29.83	— .04	66.8	+ 3.9	97	14	81	36	3	53	44	55	46	60	1.50	— 1.7	9	11,216	se.	57	se.	25	15	13	3	4.1	
Wichita	1,351	78	85	28.47	29.87	— .01	68.4	+ 4.2	90	31	79	45	4	58	40	61	56	71	5.72	+ 1.7	13	8,036	s.	36	ne.	27	9	13	9	5.5	
Oklahoma	1,218	54	62	28.60	29.87	.00	70.4	+ 2.5	87	28	79	48	4	62	31	64	60	74	9.63	+ 4.3	11	9,029	s.	52	se.	30	14	12	5	4.0	
Southern Slope.							69.8	+ 1.6										62	3.57	+ 0.8										4.2	
Abilene	1,749	45	54	28.07	29.86	— .03	74.5	+ 2.3	94	20	84	54	4	65	31	66	62	71	4.02	+ 0.4	12	8,857	se.	44	se.	29	7	18	6	5.0	
Amarillo	3,691	54	61	26.14	29.84	— .04	65.0	+ 0.8	91	14	79	36	3	51	38	53	40	54	3.12	+ 1.1	7	12,135	sw.	54	w.	25	16	12	3	3.3	
Southern Plateau.							65.9	— 3.1										20	0.01	— 0.4										2.9	
El Paso	3,767	10	110	26.07	29.81	.00	70.6	— 1.7	94	24	86	40	3	56	42	47	10	13	T.	— 0.5	0	9,235	w.	45	sw.	2	16	12	3	3.0	
Santa Fe	6,998	47	50	23.19	29.85	— .03	55.6	— 0.1	79	12	68	24	3	44	31	38	4	15	0.01	— 1.0	1	6,294	sw.	42	sw.	1	18	13	0	2.8	T.
Flagstaff	6,885	12	25	23.27	29.99	......	46.0	......	75	12	63	14	3	29	45	36	....	....	0.06	......	2	......	sw.	....	......	....	15	9	7	3.0	0.4
Phenix	1,076	47	57	28.69	29.80	— .02	71.2	— 3.1	101	13	86	39	3	56	39	50	26	22	0.00	— 0.2	0	3,670	e.	22	sw.	1	25	5	1	2.0	
Yuma	139	16	50	29.65	29.79	— .02	72.1	— 5.1	103	12	88	45	4	56	41	53	34	31	0.00	0.0	0	5,167	w.	31	w.	1	25	5	1	1.4	
Independence	3,907	10	58	25.86	29.79	— .09	60.0	— 5.4	88	11	72	34	2	48	31	43	15	21	0.03	— 0.3	2	8,496	nw.	42	w.	19	26	5	0	2.1	
Middle Plateau.							49.5	— 6.4										48	1.37	+ 0.3										5.9	
Carson City	4,720	82	92	25.20	29.97	+ .06	48.2	— 7.3	79	10	60	22	1	37	41	39	27	48	0.52	— 0.1	4	6,493	sw.	48	sw.	13	6	16	9	6.0	T.
Winnemucca	4,340	59	70	25.60	29.99	+ .08	47.7	— 6.7	77	10	59	22	3	36	40	39	27	52	1.01	0.0	7	6,870	nw.	41	nw.	29	5	7	19	7.2	T.
Salt Lake City	4,344	83	90	25.51	29.91	.00	52.6	— 5.2	83	11	64	25	2	41	34	41	25	39	2.59	+ 0.9	10	5,058	se.	56	w.	29	7	12	12	5.8	6.0
Grand Junction	4,608	43	50	25.24	29.84	......	59.0	......	85	13	72	30	2	45	37	43	19	29	0.14	......	2	5,562	nw.	32	s.	19	8	19	4	4.7	0.3
Northern Plateau.							50.7	— 5.5										60	1.49	— 0.1										6.1	
Baker City	3,470	49	55	26.38	29.98	+ .03	46.6	— 6.1	72	23	57	25	1	36	33	39	30	58	2.08	+ 0.2	12	4,104	nw.	25	nw.	11	3	10	18	7.0	0.5
Boise	2,736	61	68	27.09	29.94	.00	52.5	— 5.6	77	23	64	28	1	41	32	45	38	64	1.34	— 0.3	8	4,556	w.	26	w.	11	4	19	8	6.0	T.
Idaho Falls	4,742	10	56	25.20	30.01	+ .09	47.4	— 4.9	75	23	60	25	3	35	38	39	30	60	1.50	+ 0.3	6	9,241	s.	52	sw.	11	7	10	14	6.5	3.0
Spokane	1,943	99	107	27.90	29.95	.00	51.6	— 5.4	79	23	62	32	3	42	31	43	34	58	1.02	— 0.4	11	5,462	s.	30	sw.	11	5	16	10	6.4	
Walla Walla	1,018	65	73	28.90	29.98	+ .04	55.2	— 5.7	80	22	66	37	2	45	33	48	40	61	1.53	— 0.1	12	4,995	s.	25	sw.	11	11	18	2	4.6	
N. Pac. Coast Reg.							49.5	— 4.7										79	4.10	+ 1.1										7.9	
Fort Canby	179	10	34	29.90	30.10	+ .08	48.5	— 4.1	58	31	52	40	11	45	12	46	44	86	5.50	+ 2.3	26	8,104	w.	48	se.	30	2	5	24	8.4	
Neah	50	7	24	29.99	30.05	+ .03	46.9	— 5.6	59	22	51	35	14	43	18	45	43	87	7.60	+ 2.3	25	4,913	w.	30	w.	11	1	4	26	8.5	
Port Crescent	256	15	20	......	......	......	46.0	— 4.4	70	22	52	31	14	40	32	....	....	....	2.15	— 0.4	20	3,567	w.	20	w.	15	1	13	17	7.4	
Seattle	119	114	121	29.92	30.05	+ .05	51.4	— 3.9	68	22	58	38	14	45	23	46	42	75	2.09	0.0	21	4,489	se.	25	s.	8	0	19	12	7.2	
Tacoma	213	113	120	......	......	......	50.6	— 3.5	68	22	57	36	14	44	21	....	....	....	2.75	+ 0.2	18	4,171	sw.	24	sw.	8	0	11	20	7.6	
Astoria	......	18	....	......	......	......	50.2	— 4.2	60	31	56	38	14	45	19	....	....	....	5.57	+ 2.0	25	......	w.	....	......	....	3	6	22	....	
Portland, Oreg	153	203	213	29.90	30.06	+ .01	51.1	— 6.2	68	7	58	38	15	45	22	46	42	73	3.16	+ 0.8	18	5,088	nw.	30	s.	10	2	11	18	7.7	
Roseburg	521	56	67	29.49	30.06	+ .01	52.2	— 4.7	78	10	60	32	2	44	34	47	42	74	2.66	+ 0.7	19	3,070	nw.	18	sw.	31	2	8	21	8.2	
Mid. Pac. C'st Reg.							54.3	— 3.5										66	1.17	— 0.4										4.0	
Eureka	64	60	69	30.07	30.13	+ .12	49.6	— 3.1	59	27	53	37	2	46	15	46	44	82	1.73	— 1.3	9	6,430	nw.	36	n.	14	5	16	10	5.8	
Mount Tamalpais	2,375	11	18	27.53	30.03	......	51.2	......	82	10	58	33	1	44	21	43	35	62	1.70	......	3	17,074	nw.	78	nw.	12	17	9	5	4.1	
Red Bluff	334	54	58	29.60	29.95	+ .02	63.2	— 3.8	96	10	74	38	1	52	35	51	37	47	0.69	— 0.6	6	5,665	se.	30	se.	31	19	7	5	3.5	
Sacramento	71	106	117	29.89	29.97	+ .03	59.3	— 4.2	93	10	71	41	14	47	34	50	42	58	0.54	— 0.4	3	7,031	sw.	28	sw.	22	20	8	3	3.5	
San Francisco	153	161	167	29.87	30.03	+ .05	52.6	— 4.0	80	10	58	43	1	47	28	48	45	79	0.86	+ 0.1	2	10,346	w.	37	sw.	7	21	7	3	2.6	
Point Reyes Light	......	12	16	......	......	......	49.6	— 2.6	75	10	55	42	2	45	30	....	....	....	2.02	+ 0.1	3	21,312	nw.	75	nw.	14	13	6	12	4.8	
S. Pac. Coast Reg.							58.0	— 3.8										69	0.08	— 0.3										3.5	
Fresno	332	67	70	29.58	29.93	+ .05	63.2	— 4.8	98	11	78	38	1	49	37	51	39	49	0.06	— 0.3	1	5,834	nw.	30	nw.	14	27	3	1	1.6	
Los Angeles	330	74	82	29.61	29.96	+ .03	59.6	— 2.5	76	10	69	44	4	50	27	52	48	76	0.04	— 0.4	1	3,395	sw.	23	nw.	2	8	19	4	4.4	
San Diego	87	94	102	29.88	29.98	+ .06	57.7	— 2.7	66	3	61	48	16	54	17	52	49	74	0.10	— 0.3	3	4,708	sw.	23	nw.	1	21	3	7	4.2	
San Luis Obispo	201	10	46	29.82	30.04	+ .10	54.0	— 5.0	75	11	66	34	16	42	37	48	44	77	0.10	— 0.2	1	4,234	w.	22	w.	15	19	8	4	3.7	
West Indies.																															
Basseterre	29	41	54	30.00	30.03	......	80.0	......	86	27	75	71	15	80	14	73	70	74	0.53	......	8	7,077	e.	26	e.	25	3	21	7	5.8	
Bridgetown	30	57	65	29.96	29.99	......	49.7	......	87	23	86	69	25	74	17	73	70	74	1.46	......	8	7,603	e.	25	e.	29	0	25	6	6.2	
Cienfuegos	53	62	67	29.95	30.00	......	78.4	......	93	22	88	64	1	68	25	72	69	75	1.12	......	9	5,062	ne.	27	e.	17	22	9	0	2.2	
Colon †	25	37	47	29.85	29.88	......	80.1	......	90	4	85	70	2	75	19	76	74	84	3.76	......	8	3,386	ne.	20	nw.	16	1	13	6	6.4	
Havana	57	83	101	29.96	30.02	......	76.8	......	89	11	84	66	1	70	20	72	70	80	1.64	......	8	8,219	ne.	45	se.	25	22	7	2	2.8	
Kingston	286	38	52	29.66	29.96	......	78.2	......	91	24	86	66	2	70	20	72	69	76	4.12	......	13	4,552	ne.	26	se.	23	5	15	11	5.7	
Port of Spain	40	65	66	29.91	29.95	......	80.4	......	91	8	89	69	28	72	22	73	69	71	0.47	......	4	4,880	e.	19	e.	14	12	19	0	4.4	
San Juan	82	48	56	29.93	30.01	......	78.7	......	89	3	85	68	1	72	17	74	71	77	2.59	— 2.1	12	3,937	se.	19	e.	24	11	18	2	4.5	
Santiago de Cuba	82	45	51	29.88	29.96	......	79.4	......	91	25	88	66	1	71	19	72	69	74	3.92	......	14	3,690	n.	22	ne	3	13	14	4	4.3	
Santo Domingo	59	82	88	......	......	......	......	......	....	....	....	....	....	....	....	....	....	....	......	......	....	......	....	....	....	....	....	....	....	....	
Willemstad	75	39	46	29.84	29.92	......	80.9	......	86	21	85	75	5	77	11	74	72	76	0.07	......	1	10,432	e.	20	e.	22	11	17	3	4.5	

NOTE.—The data at stations having no departures are not used in computing the district averages. Letters of the alphabet denote mlumber of days missing from the record. *Two or more dates. † Received too late to be considered in departures, etc.

TABLE II.—*Climatological record of voluntary and other cooperating observers, May, 1899.*

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Alabama.	°	°	°	*Ins.*	*Ins.*
Alco	95	53	75.8	2.50	
Ashville	94	50	74.0	1.28	
Bermuda	......	54	......	0.91	
Birmingham	94	56	76.6	3.23	
Bridgeport	......	......	......	3.16	
Citronelle	93	61	79.0	1.19	
Daphne	92	59	78.6	0.52	
Decatur	97	52	76.6	1.17	
Demopolis	......	......	......	1.80	
Elba	100	50	76.9	2.31	
Eufaula *a*	97	54	77.3	2.18	
Evergreen	92	54	75.0	0.60	
Florence *a*	......	......	......	0.87	
Florence *b*	91	54	75.2	1.30	
Fort Deposit	96	52	77.8	0.25	
Gadsden	96	50	74.0	1.94	
Goodwater	96	52	75.0	2.79	
Greensboro	92	58	76.6	3.19	
Hamilton	97	48	76.0	0.53	
Healing Springs	95	53	75.7	1.77	
Highland Home	91	51	76.5	1.15	
Jasper	93	50	73.1	3.62	
Livingston *a*	94	55	77.7	1.71	
Lock No. 4	92	53	73.6	2.61	
Madison Station	95	51	74.8	1.16	
Maplegrove [1]	95	52	74.2	1.27	
Marion	93	55	76.9	4.80	
Mount Willing	97	57	80.2	2.30	
Newbern	92	58	77.6	2.49	
Newburg	96	50	75.2	0.93	
Newton	93	52	76.0	1.32	
Oneonta	89	50	71.8	2.95	
Opelika	95	53	76.7	2.39	
Oxanna	91	54	73.5	1.30	
Pineapple	99	52	80.4	0.80	
Pushmataha	94	56	77.6	3.42	
Riverton	96[d]	51[d]	74.2[d]	0.70	
Rockmills	95	52	74.4	2.45	
Scottsboro	98	53	73.6	2.60	
Selma	95	55	77.6	2.90	
Talladega	94	53	75.0	1.35	
Tallassee	......	......	......	1.30	
Thomasville	94	55	77.8	0.06	
Tuscaloosa	95	55	76.4	2.22	
Tuscumbia	93	55	75.8	2.19	
Union	94	54	78.7	4.04	
Union Springs	97	54	78.4	1.60	
Uniontown	94	58	79.6	2.18	
Valleyhead	92	50	71.9	1.32	
Warrior	......	......	......	3.84	
Wetumpka	99	54	77.8	2.76	
Wilson *[1]	96	60	79.2	2.56	
Alaska.					
Kenai	60	22	41.0	0.82	T.
Sitka	61	29	42.8	4.01	T.
Arizona.					
Allaire Ranch	......	......	......	0.00	
Aztec *[1]	106	51	77.1	T.	
Benson	......	......	......	0.00	
Bisbee	88	34	63.5	T.	
Blaisdell *[1]	106	54	72.8	0.00	
Bowie	......	......	......	0.00	
Buckeye	102	32	68.8	0.00	
Camp Creek	90	40	64.6	0.00	
Casa Grande *[1]	100	49	75.8	0.00	
Champie Camp	99	43	71.7	0.00	
Congress	92	43	66.9	T.	
Dragoon	......	......	......	0.00	
Dragoon Summit	......	......	......	0.00	
Dudleyville	98	30	67.4	0.00	
Fort Apache	86	23	56.8	0.00	
Fort Defiance	80	20	51.6	0.02	T.
Fort Grant	88	24	59.9	0.00	
Fort Huachuca	90	32	65.2	0.00	
Fort Mohave	109	43	74.6	0.03	
Gilabend *[1]	100	50	71.8	0.00	
Holbrook	91	21	58.6	0.10	1.0
Hot Springs	100	45	72.4	0.00	
Ingleside	103	41	70.0	0.00	
Jerome	80	35	63.1	0.00	
Lochiel *[1]	82	35	61.0	0.00	
Maricopa	......	......	......	0.00	
Mesa	99	38	68.1	0.00	
Mount Huachuca	93	29	65.0	T.	
Music Mountain	97	34	67.1	0.05	
Natural Bridge	......	......	......	0.00	
Oracle	89	32	63.8	0.00	
Oro	......	......	......	0.00	
Oro Blanco	91	36	66.7	T.	
Pantano *[1]	93	45	70.0	0.00	
Parker	109	38	73.1	0.01	
Peoria	102	43	71.9	0.00	
Phenix	108	32	72.2	0.00	
Pima	98	27	66.6	0.00	
Pinal Ranch	......	......	......	0.00	
Prescott	81	5	47.5	0.02	
Arizona—Cont'd.	°	°	°	*Ins.*	*Ins.*
San Carlos	99	30	66.0	0.00	
San Simon *[1]	93	32	65.1	0.00	
Sentinel *[1]	102	59	77.5	0.00	
Signal	103	36	69.2	T.	
Snowflake	83	23	56.0	0.00	
Strawberry	82	13	49.8	T.	
Texas Hill *[1]	108	53	77.3	0.00	
Tombstone	92	34	67.0	T.	
Tonto	94	36	66.8	0.00	
Tuba	99	26	62.2	0.00	
Tucson	98	32	68 0	T.	
Vail	......	......	......	0.00	
Walnut Grove	......	......	......	0.00	
White Hills	98	38	69.9	T.	
Willcox	......	......	......	0.00	
Winslow	84	23	55.9	T.	T.
Yarnell	......	......	......	T.	
Arkansas.					
Amity	87	54[f]	72.5[c]	11.04	
Arkansas City	......	......	......	6.70	
Beebranch	88[f]	54[f]	70.1[f]	6.20	
Blanchard Springs	94	56	75.2	2.88	
Brinkley	90	54	72.5	4.97	
Camden *a*	......	......	......	9.38	
Camden *b*	95	52	76.2	9.50	
Canton *[1]	90	50	70.4	2.37	
Conway	94	53	74.6	8.11	
Corning	92	50	71.4	3.92	
Dallas	88	57	73.0	6.62	
Dardanelle	......	......	......	8.52	
Fayetteville	87	49	70.4	7.56	
Forrest	91	54	74.0	4.43	
Fulton	......	......	......	3.96	
Hardy	......	50	......	5.29	
Helena *a*	......	......	......	3.88	
Helena *b*	92	57	74.7	3.01	
Hot Springs *a*	91	54	72.9	5.04	
Hot Springs *b*	......	......	......	5.80	
Jonesboro	96	56	74.8	6.67	
Keesees Ferry	89	50	70.6	6.68	
Lacrosse	83	51	66.9	6.98	
Lonoke	92	54	73.8	5.99	
Luna Landing *[6]	88	64	74.4	6.63	
Malvern	90	53	73.2	6.32	
Marianna	91	56	74.3	4.75	
Marvell	93	55	74.6	4.93	
Moore	......	......	......	13.36	
Mossville	85	48	67.4	8.35	
Mount Nebo	85	52	69.8	9.80	
New Gascony	90	55	74.4	5.71	
Newport *a*	......	......	......	6.47	
Newport *b*	92	54	73.2	6.33	
Newport *c*	92	53	73.2	5.99	
Oregon	89	42	70.6	5.81	
Osceola	90	55	72.7	3.66	
Ozark	91	55	73.5	8.01	
Pinebluff	93	57	74.7	8.10	
Pocahontas	87	53	70.5	5.23	
Pond	86	44	69.5	5.61	
Powell	......	51	......	6.39	
Prescott	92	56	75.8	6.19	
Rison	......	54	......	6.85	
Russellville	86	54	72.4	8.53	
Silver Springs	88	47	70.2	6.24	
Spielerville	91	51	73.0	8.33	
Stamps	91	60	76.9	4.61	
Stuttgart	90	54	73.8	7.63	
Texarkana	94	58	76.7	2.85	
Warren	92	48	75.8	7.74	
Washington	87	57	74.3	5.66	
Wiggs *[1]	88	56	71.8	7.85	
Winslow	85	50	66.8	7.37	
Witts Springs	85	47	68.3	8.61	
California.					
Agnew	92	33	57.2	0.60	
Anada	86[c]	26[c]	49.9[c]	2.79	
Arlington Heights	90	38	60.6	0.13	
Azusa	......	......	......	T.	
Ballast Point L. H	......	......	......	0.19	
Bear Valley	......	......	......	4.00	7.0
Berkeley	80	40	55.4	1.70	
Bishop	88	25	57.9	0.02	
Blue Lakes City	98	32	60.6	1.14	
Boca *[1]	70	20	40.6	2.49	21.5
Bodie	68	13	36.9	0.74	6.5
Bowmans Dam	......	......	......	4.80	14.0
Caliente *[1]	92	45	67.6	1.13	
Campbell	91	31	53.0	0.30	
Cape Mendocino L. H	......	......	......	2.05	
Cedarville	77	23	46.0	1.50	4.0
Centerville *[1]	96	42	59.2	0.66	
Chico *[1]	92	45	65.6	0.81	
Chino	......	......	......	0.00	
Cisco *[1]	62	18	38.2	2.10	14.0
Claremont	84	34	57.4	0.01	
Corning *[1]	96	52	64.8	1.15	
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Coronado	68	55	60.9	......	
Craftonville	91	43	62.0	0.23	
Crescent City	66	33	49.4	4.40	
Crescent City L. H	......	......	......	3.89	
Cuyamaca	76	22	47.4	0.47	
Delano *[1]	101	47	66.0	0.09	
Delta *[1]	90	38	60.6	1.10	
Dunnigan *[1]	92	45	66.2	0.44	
Durham *[1]	92	38	62.0	2.08	
East Brother L. H	......	......	......	0.35	
Edmanton *[1]	79	22	46.0	2.92	5.0
El Cajon	82	36	59.4	0.04	
Elsinore	100	31	64.8	T.	
Escondido	84	30	59.8	0.15	
Fallbrook *[1]	81	43	59.0	0.18	
Folsom City *[1]	94	48	63.9	1.17	
Fordyce Dam	......	......	......	2.91	15.0
Fort Ross	67	38	51.2	3.92	
Georgetown	81	26	52.5	2.32	
Gilroy (near)	86	34	56.7	0.74	
Gilroy Hot Springs	......	......	......	0.60	
Glendora	......	......	......	0.79	
Goshen *[5]	98	40	69.3	0.00	
Grand Island *[5]	95	42	63.0	0.88	
Grass Valley	......	......	......	2.72	
Greenville	85	23	48.2	1.44	1.0
Healdsburg	94	34	58.8	2.01	
Hollister	87	32	54.5	0.00	
Humboldt L. H	......	......	......	2.81	
Indio *[1]	102	61	77.1	0.00	
Iowa Hill *[1]	81	34	54.4	2.41	
Irvine	84	56	67.8	T.	
Jackson	100	34	59.2	1.07	T.
Jolon	......	......	......	0.17	
Kennedy Gold Mine	86	32	54.4	2.33	
Kernville	......	......	......	0.41	
King City *[1]	82	40	51.4	0.13	
Kingsburg *[5]	95	55	69.8	0.00	
Kono Tayee	84	38	57.6	0.45	
Lagrange *[5]	98	40	64.6	0.90	
Lakeside	......	......	......	0.15	
Lamesa	......	......	......	0.12	
Laporte *[1]	74	26	44.2	4.43	12.7
Las Fuentes Ranch	......	......	......	1.04	
Lemoncove	100	31	64.0	0.63	
Lemoore *a* *[1]	96	42	65.0	0.00	
Lick Observatory	75	26	46.3	1.47	
Lime Point L. H	......	......	......	0.88	
Lodi	91	37	59.9	0.55	
Los Gatos *b*	91	31	54.2	0.83	
Malakoff Mine	83	26	52.7	3.91	2.0
Mammoth Tank *[1]	105	50	77.7	0.00	
Manzana	97	38	62.4	0.09	
Mare Island L. H	......	......	......	0.33	
Merced *[1]	96	45	63.4	0.70	
Mills College	......	......	......	1.51	
Milo	......	......	......	0.00	
Milton (near) *[1]	92	38	59.2	1.81	
Modesto *[1]	94	42	63.5	0.11	
Mohave *[1]	95	43	60.9	T.	
Mokelumne Hill *[3]	......	40	55.5	1.58	
Monterey *[1]	74	48	56.4	0.50	
Morena Dam	85	28	54.6	0.28	
Mountain View	......	......	......	0.27	
Napa *b*	93	33	57.0	0.40	
Needles	106	48	76.2	0.09	
Nevada City	81	28	51.6	2.61	
Newhall *[1]	90	43	60.4	0.00	
North Ontario	84	38	57.6	0.05	
North San Juan *[1]	82	31	55.0	3.00	0.5
Oakland *a*	84	40	57.0	1.64	
Ogilby *[1]	105	60	78.5	0.00	
Oleta *[1]	86	40	55.2	1.01	
Orland *[1]	100	50	66.5	0.94	
Palermo	95	35	62.9	0.92	
Paso Robles *b*	87	37	56.8	T.	
Peachland *[5]	84	42	58.4	1.99	
Piedras Blancas L. H	......	......	......	1.15	
Pigeon Point L. H	......	......	......	0.50	
Pilot Creek	......	......	......	2.83	4.0
Pine Crest	73	40	56.8	0.00	
Placerville	84	29	53.9	1.78	
Point Ano Nuevo L. H	......	......	......	1.22	
Point Arena L. H	......	......	......	2.32	
Point Bonita L. H	......	......	......	1.23	
Point Conception L. H	......	......	......	0.10	
Point Firmin L. H	......	......	......	0.00	
Point George L. H	......	......	......	2.13	
Point Hueneme L. H	......	......	......	0.00	
Point Lobos	67	38	51.3	0.86	
Point Loma L. H	......	......	......	0.00	
Point Montara L. H	......	......	......	1.84	
Point Pinos L. H	......	......	......	0.77	
Point Sur L. H	......	......	......	0.69	
Pomona (near)	87	39	62.2	0.00	
Poway *[3]	78	49	57.3	0.44	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
	°	°	°	Ins.	Ins.
California—Cont'd.					
Quincy	82	25	49.8	2.28	T.
Ranch House	88	50	67.0	0.09	
Raymond	98	32	60.4	0.13	
Redlands	91	39	60.8	0.24	
Represa	88	40	60.3	1.12	
Rio Vista	93	37	61.2	0.13	
Roe Island L. H	......	......	......	0.42	
Romie	90	30	56.0	0.10	
Rosewood	97	36	60.9	2.09	
Sacramento *a*	90	38	61.1	0.93	
Salinas *1	75	50	60.8	0.71	
Salton *1	109	58	76.6	0.00	
San Bernardino	93	33	60.4	0.19	
San Leandro *1	84	44	57.8	1.18	
San Luis L. H	......	......	......	0.85	
San Mateo *1	84	48	58.0	0.67	
San Miguel *1	93	41	60.0	......	
Santa Barbara *a*	72	40	56.4	0.00	
Santa Barbara L. H	......	......	......	0.00	
Santa Clara *a*	......	......	......	0.19	
Santa Cruz *b*	74	31	53.6	0.95	
Santa Cruz L. H	......	......	......	1.07	
Santa Maria	74	37	55.8	0.75	
Santa Monica *1	70	52	60.9	0.00	
Santa Paula	83	45	61.4	0.00	
Santa Rosa *1	88	37	56.6	2.00	
Shasta	95	40	62.2	2.34	
Sierra Madre	81	44	59.3	0.25	
Sonoma	......	......	......	1.32	
S. E. Farallone L. H	......	......	......	1.15	
Stanford University	89	30	54.4	0.42	
Stockton *a*	89	40	58.6	0.47	
Summerdale	75	21	45.8	0.99	
Susanville	78	26	48.9	1.42	10.0
Tehama *1	91	44	65.8	1.86	
Tejon Ranch	95	42	64.6	0.35	
Templeton *1	95	40	55.1	0.05	
Thermalito	93	35	63.0	2.78	
Trinidad L. H	......	......	......	3.05	
Truckee *1	67	30	44.0	0.75	
Tulare *b*	......	......	......	0.00	
Tulare *c*	100	34	64.1	0.02	
Ukiah	90	30	54.6	2.05	
Upperlake	92	33	56.4	1.00	
Upper Mattole	......	......	......	2.84	
Vacaville *a* *1	94	50	61.8	1.25	
Ventura	75	46	60.4	T.	
Visalia *1	97	48	64.9	0.03	
Volcano Springs *1	110	55	79.4	0.00	
Walnut Creek	96	36	64.0	0.83	
West Palmdale	......	......	......	T.	
Westpoint	......	......	......	1.78	T.
West Saticoy	......	......	......	0.73	
Wheatland	93	34	61.1	1.08	
Williams *1	92	50	66.2	0.15	
Wilmington *1	79	46	60.8	T.	
Wire Bridge *5	92	41	62.4	1.34	
Yerba Buena L. H	......	......	......	0.80	
Yreka	84	20	52.0	0.62	
Yuba City *5	92	44	67.8	1.54	
Colorado.					
Antlers	84	25	56.2	0.01	
Arkins	......	......	......	0.67	2.0
Boulder	82	29	57.0	0.55	
Boxelder	......	......	......	0.52	
Breckenridge	63	4	34.4	0.31	5.4
Canyon	88	30	59.5	0.12	T.
Castlerock	84	31	55.5	0.53	0.2
Cedaredge	85	24	54.0	0.10	0.8
Cheyenne Wells	91	26	59.6	2.88	
Clearview *1	66	14	42.1	0.12	1.0
Collbran	......	......	......	T.	T.
Colorado Springs	81	23	54.4	0.67	T.
Cope	92	26	59.2	0.23	
Crook	85	25	57.2	2.60	
Delta	90	25	57.4	0.15	
Dumont	......	......	......	0.62	T.
Durango	81	18	52.6	0.01	
Fairview	75	20	46.7	0.97	1.0
Fort Collins	82	23	53.8	1.01	
Fort Morgan	100	23	56.8	1.82	
Fox	......	......	......	0.35	
Garnett	79	10	47.0	0.07	
Georgetown	68	20	45.8	......	
Gleneyrie	......	......	......	0.10	
Greeley	81	25	55.8	1.15	
Gunnison	82[f]	18[f]	51.3[f]	T.	T.
Hamps	86	21	55.5	0.30	2.5
Hoehne	91	20	58.2	0.22	
Hylyoke	......	......	......	2.32	
Holyoke (near)	86	26	58.6	1.53	
Hugo	......	......	......	0.70	2.0
Husted	82	19	53.8	0.90	T.
L ke Moraine	65	9	42.2	0.54	5.0
Lamar	95	31	64.8	2.39	
Laporte	......	......	......	0.88	
Colorado—Cont'd.					
Las Animas	94	30	62.5[e]	0.88	
Leadville (near) *1	65	14	41.2	0.17	2.2
Leroy	84	21	54.7	2.93	T.
Longs Peak	66	17	41.7	0.38	5.0
Loveland	......	......	......	0.90	
Mancos	80[e]	11[e]	49.5[e]	0.20	2.5
Meeker	84	19	50.2	0.24	1.8
Minneapolis	98	25	63.0	0.87	
Moraine	70	20	45.1	0.45	T.
Pagoda	80	22	49.2	0.42	2.5
Parachute	86	29	57.4	0.08	0.8
Rangely	80	21	52.8	0.00	
Rockyford	94	32	61.8	0.99	
Ruby	......	......	......	2.20	31.0
Saguache	73	16	49.1	T.	T.
Salida	80	20	52.0	T.	T.
San Luis	76	14	47.4	0.13	T.
Santa Clara *1	79	33	52.8	0.20	T.
Seibert	......	......	......	T.	
Smoky Hill Mine	75	16	46.0	1.11	
Springfield	......	......	......	0.29	
Strickler Tunnel	......	......	......	0.62	9.8
Trinidad	......	......	......	0.13	
Troutvale	68[e]	6[d]	38.4[e]	0.33	5.5
T. S. Ranch	82	24	55.2	0.28	3.0
Vilas	......	......	......	1.17	
Wagon Wheel	68	3	36.0	0.33	0.5
Walden	72	16	44.3	0.30	2.0
Wallet	......	......	......	0.32	
Westcliffe	74	17	48.6	0.25	
Wray	86	29	60.4	1.96	
Yuma	......	......	......	1.23	
Connecticut.					
Bridgeport	86	37	58.9	2.03	
Canton	87	31	57.3	2.09	
Colchester	83	33	58.1	2.11	
Falls Village	......	......	......	2.68	
Greenfield Hill	......	......	......	2.10	
Hartford *a*	84	39	59.1	2.46	
Hartford *b*	......	......	......	2.11	
Hawleyville	86	35	58.7	2.13	
Lake Konomoc	......	......	......	2.72	
Middletown	84	31	58.9	2.67	
New London	79	39	56.4	2.52	
North Grosvenor Dale	......	......	......	1.85	
Norwalk	87	28	57.9	2.65	
Southington	84	32	58.7	1.75	
South Manchester	......	......	......	2.22	
Storrs	84	33	56.2	1.27	
Voluntown	82	32[e]	56.6	1.52	
Wallingford	......	......	......	2.01	
Waterbury	87	32	58.6	2.07	
West Cornwall	83	33	56.2	1.75	
West Simsbury	......	......	......	2.04	
Winsted *1	86	42	56.4	......	
Delaware.					
Millsboro	92	38	62.8	2.55	
Milford	96	39	63.8	2.29	
Newark	88	39	62.0	2.61	
Seaford	93	40	64.0	2.08	
Wyoming	......	......	......	2.85	
District of Columbia.					
Distributing Reservoir *5	89	50	66.8	1.83	
Receiving Reservoir *5	89	49	66.2	2.35	
West Washington	90	41	65.2	3.43	
Florida.					
Archer	101	58	79.4	0.83	
Bartow	95	60	79.8	1.01	
Boca Raton	91	62	76.8	0.82	
Brooksville	96	62	79.4	0.60	
Carrabelle	92	63	78.1	1.00	
Clermont	100	64	80.8	2.29	
Dalkeith	96	58	78.9	......	
De Funiak Springs	98	57	77.4	0.50	
Earnestville	99	63	80.6	1.38	
Estero *1	91	65	77.5	......	
Eustis	100	61	79.4	0.79	
Federal Point	94	60	76.6	1.90	
Gainesville	99	60	80.1	1.75	
Grasmere	98	62	79.0	0.74	
Haywood	......	......	......	1.35	
Homeland	92	59	75.5	......	
Huntington	97	59	77.7	0.95	
Inverness	95	61	77.6	1.47	
Jasper	96	58	77.8	1.95	
Kissimmee	95	64	80.6	1.60	
Lake Butler	99	60	79.0	0.53	
Lake City	100	60	79.0	1.37	
Lemon City	92	64	78.8	1.40	
Macclenny	99	58	78.0	4.03	
Manatee	95	59	76.8	1.85	
Merritts Island	93	68	79.0	0.37	
Myers	92	61	77.4	1.15	
New Smyrna	97	59	75.9	1.00	
Ocala	99	60	78.8	0.62	
Orange City	97	64	80.3	0.56	
Florida—Cont'd.					
Orlando	94	64	79.0	0.96	
Plant City	98	59	78.2	1.00	
St. Andrews	98	60	78.2	0.65	
St. Francis	96	55	75.3	1.23	
St. Francis Barracks	96	60	76.6	0.25	
Sebastian	92	66	77.0	1.12	
Stephensville *1	94	64	77.5	0.30	
Switzerland *1	94	59	77.2	1.25	
Tallahassee	94	56	78.2	0.54	
Tarpon Springs *	90	61	75.9	0.13	
Wausau	99	52	79.4	2.85	
Georgia.					
Adairsville	91	54	72.6	3.72	
Alapaha	96	56	76.0	2.28	
Albany	97	54	77.5	1.30	
Allentown	97	50	76.3	1.72	
Americus	96	54	77.3	2.70	
Athens *b*	95	52	74.1	0.83	
Bainbridge	100	53	78.8	3.50	
Bellville	95	56	75.8	0.89	
Blakely	......	......	......	1.30	
Camak	98	49	75.6	0.79	
Canton	......	......	......	0.76	
Carlton	......	......	......	1.64	
Cartersville	92	53	72.9	T.	
Clayton	94	44	69.5	1.98	
Columbus	99	54	76.8	3.03	
Covington	98	51	76.0[e]	3.26	
Crescent	......	......	......	1.12	
Dahlonega	90	47	68.5	1.06	
Diamond	94	41	68.8	3.84	
Dublin	......	......	......	1.74	
Eastman	97	54	77.4	2.01	
Elberton	95	52	75.0	0.79	
Fitzgerald	96	56	79.1	2.40	
Fleming	101	50	76.0	0.89	
Fort Gaines	96	54	78.0	2.08	
Franklin	91	54	75.4	0.64	
Gainesville	89	52	70.8	1.46	
Gillsville	95	50	74.3	2.35	
Greenbush	91	50	71.6	1.08	
Griffin	96	49	72.7	3.23	
Harrison	98	48	77.4	1.71	
Hephzibah	......	......	......	0.97	
Jesup	100	49	75.6	2.84	
Lagrange	95	50	74.5	1.44	
Leverett	99	45	75.8	0.73	
Louisville	98	52	76.2	1.60	
Lumpkin	96	55	79.0	2.47	
Marshallville	96	55	78.6	1.46	
Mauzy	100	50	78.2	5.44	
Millen	99	50	76.9	0.66	
Morgan	98	56	77.8	0.54	
Newnan	97	52	75.2	1.52	
Point Peter	98	48	72.2	0.68	
Poulan	95	49	74.2	1.75	
Putnam	98	53	76.6	3.18	
Quitman	100	50	78.3	1.19	
Ramsey	92	47	72.5	1.22	
Rome	90	53	73.4	2.63	
Talbotton	97	52	75.1	1.73	
Tallapoosa	91	52	72.0	1.52	
Thomasville	97	53	79.0	1.27	
Toccoa	98	......	......	0.80	
Union Point	93	51	73.8	0.86	
Washington	95	51	75.3	2.51	
Way Cross	97	58	77.8	2.85	
Waynesboro	96	49	74.0	0.57	
Westpoint	96	53	75.8	1.51	
Idaho.					
American Falls	78	25	49.1	1.36	
Atlanta	70	11	42.4	2.12	
Blackfoot	83	21	50.4	1.18	0.8
Burnside	70	16	45.0	0.35	3.5
Challis	80	18	50.2	1.90	
Chesterfield	75	8	43.4	......	
Downey	75	10	46.4	0.65	1.0
Fort Sherman	80	26	47.0	1.23	
Gimlet	74	17	46.0	1.76	2.5
Gray	68	9	43.2	1.00	0.6
Hagerman	88	25	55.6	0.63	
Idaho City	82[e]	19[e]	48.9[e]	1.23	T.
Kootenai	84	23	49.6	3.50	
Lake	62	6	37.8	1.87	18.7
Lakeview	76	26	49.5	2.22	
Lewiston	74	36	58.5	1.34	
Lost River [f]	73	15	45.4	0.86	T.
Marysville	78	6	41.4	2.33	
Moscow	72	27	47.8	2.12	T.
Murray	77	24	46.8	2.91	1.0
Oakley	84	25	51.2	1.10	T.
Ola	79	24	51.2	2.42	
Paris	77	19	47.8	0.65	
Payette	82	25	56.8	1.05	
Pollock	78	28	51.9	2.23	
Priest River	80	27	48.4	2.76	T.

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Temperature. (Fahrenheit.) Minimum.	Temperature. (Fahrenheit.) Mean.	Precipitation. Rain and melted snow.	Precipitation. Total depth of snow.
Idaho—Cont'd.	°	°	°	*Ins.*	*Ins.*
St. Maries	78	27	50.4	1.25	
Salubria	78	23	50.2	2.02	
Soldier	78	17	46.8	0.84	1.0
Swan Valley	76	12	46.6	2.68	13.0
Weston f	81	23	50.6	1.05	3.0
Yellow Jacket	......	......	......	0.89	
Illinois.					
Albion	88	46	68.0	3.66	
Alexander	89	43	65.2	9.15	
Ashton	82	37	60.3	6.04	
Astoria	90	42	63.4	8.38	
Aurora a	86	40	61.8	7.34	
Aurora b	84	40	60.7	9.48	
Beardstown	......	......	......	11.28	
Bloomington	90	41	65.2	4.06	
Bushnell	88	43	65.0	7.68	
Cambridge	82	41	61.8	6.15	
Carlinville	90	43	66.0	7.01	
Carlyle	......	......	......	4.18	
Carrollton	85	44	64.9	8.01	
Charleston	86	43	64.8	6.86	
Chemung	82	35	59.0	5.61	
Chester	......	......	......	1.84	
Cisne	88	46	66.8	3.91	
Coatsburg	87	40	65.0	8.19	
Cobden	89	49	68.1	6.06	
Danville	91	37	65.6	3.91	
Decatur	88	39	64.6	7.01	
Dixon	84	39	61.7	6.76	
Dwight *1	86j	41j	65.4j	2.08j	
Effingham	87	46	66.0	5.49	
Elgin	83	37	58.6	5.20	
Equality	92	47	66.5	3.86	
Flora	87	45	65.9	2.73	
Fort Sheridan	82	37	55.9	6.04	
Friendgrove	88	50	68.4	3.58	
Galva	83	41	61.8	6.07	
Glenwood	......	......	......	7.58	
Grafton	......	......	......	8.02	
Grayville	90	51	69.6	2.65	
Greenville	90	47	67.3	5.47	
Griggsville	89	44	65.8	13.10	
Halfway	88d	50d	70.0d	3.18	
Halliday	87	45	67.2	3.30	
Havana	85	46	61.6	7.31	
Henry	85	41	62.9	5.64	
Hillsboro	91	45	65.6	7.28	
Joliet	85	40	61.4	4.69	
Kankakee	89	41	64.0	3.90	
Knoxville	87	40	61.6	6.87	
Lagrange	84	37	59.9	5.98	
Laharpe	86	43	63.1	12.57	
Lanark	83	33	58.2	7.74	
Loami	......	......	......	10.51	
McLeansboro	88	48	67.8	3.82	
Martinsville	86	43	64.5	5.20	
Martinton	88	39	62.7	4.02	
Mascoutah	89	43	65.9	5.56	
Mattoon	84	42	63.8	7.41	
Minonk	85	39	62.2	4.59	
Monmouth	85	39	61.6	6.61	
Monticello	......	......	......	6.02	
Morrisonville	88	42	63.8	5.66	
Mount Carmel	......	......	......	3.35	
Mount Pulaski	87	43	65.3	9.83	
Mount Vernon	87	45	65.6	4.19	
New Burnside	93	45	70.2	5.37	
Olney	90	44	66.8	2.98	
Oswego	85	38	61.6	7.28	
Ottawa	87	37	61.3	5.08	
Palestine	88	43	64.8	3.26	
Pana	87	43	64.7	6.84	
Paris	89	42	63.5	4.90	
Peoria a	......	......	......	6.00	
Peoria b	90	44	65.5	6.03	
Philo	87	40	63.1	4.44	
Plumhill	85	45	66.6	6.19	
Rantoul	88	42	62.8	5.81	
Raum	89	51	70.3	6.20	
Riley	86	38	60.1	4.61	
Robinson	89	48	65.0	5.87	
Rockford	80	40	60.6	6.91	
Roundgrove	84	39	62.8	7.51	
St. Charles *1	82	44	60.7	5.62	
St. John	90	48	69.1	3.03	
Savanna	91	......	......	7.96	
Scales Mound	83	36	59.2	7.27	
Strawn	86	39	61.8	3.41	
Streator	87	36	61.0	2.50	
Sullivan	88	40	64.4	6.81	
Sycamore	84	37	60.0	3.32	
Tilden	87	42	67.0	3.04	
Tiskilwa	85	41	62.1	5.25	
Tuscola	89	38	63.7	4.39	
Walnut	83	42	63.2	6.68	
Wheaton *2	......	44	59.5	7.15	
Illinois—Cont'd.					
Winchester	88	44	65.6	9.13	
Winnebago	81	36	57.7	6.56	
Indiana.					
Anderson	86	42	63.2	2.58	
Angola	84	38	60.7	4.43	
Auburn	87	39	62.0	3.62	
Bedford	......	......	......	2.27	
Bloomington	88	46	65.3	4.18	
Bluffton	88	40	63.7	3.31	
Booneville	88	44	65.0	4.26	
Bright	90	37	64.4	4.98	
Butlerville	88	42	65.8	4.68	
Cambridge City	87	41	62.5	2.17	
Columbia City *1	82	40	62.1	4.30	
Columbus	86	41	63.6	3.34	
Connersville	88	42	64.0	2.77	
Delphi	89	36	63.0	4.50	
Edwardsville *1	86	51	69.2	5.57	
Fairmount	86	42	65.0	4.13	
Farmland	86	40	62.1	2.15	
Fort Wayne	87	39	62.6	2.83	
Franklin *1	89	52	65.6	4.08	
Greencastle	84	44	63.4	3.73	
Greensburg	86	44	63.0	3.96	
Hammond	84	40	61.8	4.07	
Hector	89	41	64.1	3.64	
Huntington	86	41	62.8	3.02	
Jeffersonville	90	47	68.4	3.85	
Knightstown	89	43	64.4	2.29	
Kokomo	90	42	65.7	4.19	
Lafayette	87	39	63.7	3.08	
Laporte	91	38	63.4	4.47	
Logansport	88	39	63.8	4.34	
Madison	88	46	67.4	5.40	
Marengo	86	42	64.8	6.11	
Marion	89	40	63.5	4.10	
Markle	87	39	62.4	3.10	
Mauzy	88	41	63.2	3.15	
Michigan City *10	85	38	59.1	......	
Mount Vernon	88	44	67.2	4.74	
Northfield	87	41	62.6	3.94	
Paoli	90	44	67.4	4.39	
Peru	87	39	63.1	2.66	
Prairie Creek	89	43	66.2	4.16	
Princeton	90	45	64.9	1.85	
Richmond	87	41	63.7	1.87	
Rockville	86	41	63.2	5.76	
Salem	88	40	64.0	4.51	
Scottsburg	89	46	67.6	3.82	
Seymour	88	48	65.6	3.30	
Shelbyville	88	44	61.6	4.08	
South Bend	85	39	62.8	4.52	
Syracuse	87	38	62.4	5.42	
Terre Haute	87	46	65.2	4.68	
Topeka	84	39	60.2	4.66	
Valparaiso	86	42	61.5	3.80	
Vevay	93	47	69.0	8.15	
Vincennes	93	45	67.4	4.35	
Washington	96	42	67.6	3.63	
Winamac	90	38	63.4	5.05	
Worthington	89	43	65.6	5.07	
Indian Territory.					
Hartshorne	90	60	75.6	6.25	
Healdton	96	48	74.9	6.22	
Kemp	93	50	74.0	4.54	
Lehigh	90	51	74.0	9.72	
Muscogee	86	47	71.0	5.33	
Ryan	93	49	75.8	4.22	
Sapulpa	87	45	70.6	3.70	
South McAlester	......	......	......	7.00	
Tahlequah	86	53	71.7	9.20	
Tulsa	......	......	......	7.51	
Wagoner	88	44	71.4	6.01	
Webbers Falls	......	......	......	5.49	
Iowa.					
Afton	87	36	61.7	6.76	
Albia	87	37	62.0	5.94	
Algona *1	84	41	59.0	3.31	
Alta a	85	32	58.8	7.75	
Amana	83	37	61.4	7.92	
Ames b	89	36	60.5	7.23	
Ames (near)	......	......	......	7.34	
Atlantic	86	30	60.1	6.08	
Audubon	83	37	59.3	8.14	
Bancroft	84	32	58.2	5.62	
Batavia	......	......	......	5.95	
Baxter	82	35	60.5	8.96	
Bedford	89	38	62.8	5.73	
Belknap	83	42	63.2	7.45	
Belleplaine	84d	38d	58.8d	8.60	
Blockton	85	41	62.0	7.81	
Bonaparte	84	40	62.4	8.35	
Britt	83	28	60.0	4.77	
Burlington	87	41	63.7	6.16	
Bussey	......	......	......	6.30	
Carroll	85	32	58.3	9.04	
Iowa—Cont'd.					
Carson	......	......	......	5.99	
Cedar Rapids	85	41	63.4	9.21	
Centerville	84	40	62.2	6.70	
Chariton	84	38	61.1	6.95	
Charles City	81	32	59.0	4.71	
Chillicothe	......	......	......	6.43	
Clarinda	88	36	62.2	7.09	
Clear Lake	86	32	59.4	11.43	
Clinton	85	39	61.4	8.38	
College Springs	89	41	63.4	8.13	
Coon Rapids	82	36	59.5	6.26	
Corning	84	37	60.9	5.56	
Council Bluffs	87	41	62.9	4.42	
Cresco	83	31	57.4	3.86	
Cumberland	......	......	......	5.01	
Danville	......	......	......	5.81	
Decorah	83	34	58.9	3.33	
Delaware	86	36	59.3	7.44	
Denison	84	34	59.3	4.82	
Desoto	90	36	61.3	6.60	
Diagonal	86	35	61.0	7.60	
Dows	88	29	58.4	5.84	
Eldon	86	37	63.9	8.69	
Eldora	87	28	59.6	7.95	
Elkader	86	35	60.0	5.13	
Emerson	......	......	......	5.60	
Estherville	89	28	57.1	4.93	
Fairfield	82	41	61.9	6.43	
Fonda	......	32	......	9.12	
Forest City	81	31	57.9	3.79	
Fort Madison	......	......	......	12.24	
Galva	86	32	59.2	4.78	
Gilman	......	......	......	6.70	
Gladbrook	......	......	......	5.32	
Glenwood	87	36	62.0	5.76	
Grand Meadow *1	78	30	57.6	4.72	
Greene	84	31	59.7	6.85	
Greenfield	86	36	60.0	6.69	
Grinnell	81	38	60.6	6.68	
Grinnell (near)	84	37	60.4	7.18	
Griswold	......	......	......	5.13	
Grundy Center	83	33	58.4	9.15	
Guthrie Center	82	34	59.2	6.52	
Hamburg	......	......	......	6.12	
Hampton	83	33	58.9	8.40	
Harlan	85	34	60.4	4.49	
Hawkeye	......	......	......	5.57	
Hedrick	85	39	62.4	5.92	
Hopeville	84	40	60.8	5.89	
Humboldt	86	33	59.8	6.27	
Independence	82	35	58.8	5.80	
Indianola	83	38	61.7	6.58	
Iowa City	86	38	62.0	9.49	
Iowa Falls	84	32	58.4	3.65	
Keosauqua	86	41	63.9	7.42	
Knoxville	85	39	61.6	5.61	
Lacona	......	......	......	7.20	
Lamoni	86	37	61.6	7.43	
Lansing	85	36	60.3	3.87	
Larrabee	86	27	57.2	4.53	
Leclaire	......	......	......	6.57	
Lemars	87	29	59.0	4.72	
Lenox	83	39	61.3	5.86	
Lockridge	......	......	......	4.98	
Logan	88	40	61.4	3.62	
Maple Valley	......	......	......	7.29	
Maquoketa	84	38	60.4	6.74	
Marshall	82	33	59.4	7.36	
Mason City	82c	32c	56.9c	3.29	
Monticello	84	36	60.1	6.19	
Mooar	85	41	62.8	10.34	
Mountayr	85	40	61.4	7.55	
Mount Pleasant	88	36	62.8	7.30	
Mount Vernon a *1	86	40	61.4	9.28	
Mount Vernon b	87	38	61.8	11.20	
Murray	......	......	......	6.88	
New Hampton	80	30	58.4	4.37	
Newton	84	37	60.8	6.61	
Northboro	......	......	......	3.94	
North McGregor	......	......	......	3.50	
Northwood	83	30	56.8	3.59	
Odebolt	88	29	59.8	5.48	
Ogden	87	31	59.6	7.80	
Olin	83	39	59.9	7.58	
Onawa	86	34	62.1	3.62	
Osage	81	32	57.5	3.71	
Osceola	85	37	60.6	7.85	
Oskaloosa	88	38	62.1	5.58	
Ottumwa	86	40	62.2	7.95	
Ovid	84	38	61.2	7.03	
Pacific Junction	85	34	61.0	4.63	
Pella	82	39	59.4	4.83	
Plover	87	31	59.6	5.55	
Primghar	87	30	57.8	3.95	
Redoak	87	40	63.2	6.13	
Ridgeway	85	34	58.8	3.09	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Rockwell City	83	31	59.0	4.71	
Ruthven	84	28	58.9	3.30	
Scranton	84	35	59.4	5.31	
Sheldon	87	28	56.6	4.49	
Sibley	87	28	56.1	5.80	
Sigourney	88	36	62.1	7.79	
Sioux Center	85	31	58.2	5.02	
Spencer	85	27	58.1	5.28	
Spirit Lake	87	30	58.4	3.94	
Storm Lake	81	31	57.4	7.37	
Stuart	85	32	60.4	6.85	
Tara	88	45	64.9	7.50	
Thurman	88	39	62.8	7.05	
Toledo	85	35	60.0	8.56	
Villisca	86	35	61.8	6.45	
Vinton *[1]	80	43	60.3	......	
Wapello	87	41	63.8	4.64	
Washington	83	38	60.7	5.27	
Washta	......	......	......	5.22	
Waterloo	84	36	59.8	6.08	
Waverly	83	37	60.2	4.68	
Westbend *[1]	83	40	56.4[d]	4.04	
Westbranch	81	36	60.6	8.62	
Westunion	......	......	......	8.53	
Whitten *[1]	83	40	60.8	......	
Wilton Junction	......	......	......	8.62	
Winterset	86	36	60.8	6.77	
Woodburn	......	......	......	7.81	
Kansas.					
Abilene	96	42	69.9	3.48	
Achilles	......	......	......	1.84	
Altoona *[3]	87	54	68.8	3.08	
Anthony	......	......	......	4.13	
Atchison *a*	88	43	66.5	3.60	
Atchison *b* *[1]	89	48	68.1	5.62	
Augusta	89	42	68.2	4.51	
Baker	91	41	66.3	4.48	
Burlington	90	38	69.4	3.01	
Campbell	92	40	66.4	8.43	
Centropolis *[1]	89	42	66.8	2.50	
Chanute	88	42	67.6	3.28	
Colby	98	24	61.8	1.82	
Columbus	89	44	69.4	6.99	
Coolidge	96	26	63.2	3.18	
Cunningham	93	36	67.7	3.48	
Dresden	90	30	62.0	2.46	
Ellinwood	97	35	67.8	3.73	
Emporia	88	43	69.1	2.50	
Englewood	98	30	69.0	1.17	
Eskridge	91	37	68.6	4.43	
Eureka	......	......	......	3.36	
Eureka Ranch	105	29	67.2	0.85	
Fallriver	88	40	68.8	4.20	
Fanning	89	37	65.3	3.74	
Fort Riley	90	......	......	0.80	
Fort Scott	89	42	69.4	5.73	
Frankfort	91	37	66.5	5.70	
Garden City	101	31	67.2	0.42	
Garfield	......	......	......	1.01	
Gibson	101	28	65.5	0.49	
Gove *[1]	101	40	67.7	4.89	
Grenola	80	39	68.4	7.37	
Halstead	94	40	68.6	4.36	
Hays	104	29	64.6	2.10	
Horton	89	43	66.2	4.45	
Hutchinson	93	42	68.3	3.57	
Independence	90	46	70.3	4.75	
Lawrence *[1]	87	42	67.2	4.79	
Lebanon	96	35	65.2	1.00	
Lebo	91	40	69.4	2.08	
Macksville	98	34	67.2	0.26	
McPherson	96	38	67.4	3.45	
Manhattan *b*	93	40	68.6	4.60	
Manhattan *c*	94	37	69.0	4.30	
Marion	......	34	......	6.90	
Meade	99	35	66.4	0.86	
Medicine Lodge	97	41	70.8	5.87	
Minneapolis	98	36	67.6	2.44	
Morantown	86	44	67.6	3.51	
Mounthope *[1]	90	50	68.9	4.17	
Ness City	102	32	68.2	1.03	
Newton	90	41	67.6	3.98	
Norwich	91[e]	43	69.2[d]	7.87	
Oberlin	......	......	......	8.15	
Olathe	86	40	68.2	2.78	
Osage City	90	35	68.4	3.44	
Osborne	......	......	......	2.27	
Oswego	88	45	70.7	4.90	
Ottawa	90	36	68.0	2.87	
Paola	89	38	67.2	5.58	
Phillipsburg	100	30	65.4	3.66	
Pittsburg	88	49	70.0	4.34	
Pratt	94	39	67.8	2.59	
Rome *[1]	91	41	68.1	5.61	
Russell	104	32	67.9	2.64	
Salina	96	38	68.4	4.80	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Kansas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Sedan	88	41	68.6	6.83	
Seneca	88	38	65.0	6.60	
Toronto	87	37	67.2	3.82	
Valley Falls	89	40	68.5	3.36	
Viroqua	99	30	65.8	0.50	
Wallace	......	......	......	1.43	
Wamego *[1]	92	42	67.4	4.14	
Wellington	90	46	70.4	7.02	
Winfield	95	38	70.4	6.07	
Winona	......	......	......	4.00	
Yates Center	......	41	......	4.38	
Kentucky.					
Alpha *[3]	......	54	68.8	5.16	
Bardstown	91	46	69.2	2.71	
Blandville	88	51	69.4	5.63	
Bowling Green *b*	88	52	70.4	4.83	
Burnside	......	......	......	5.65	
Canton *[1]	93	53	70.8	4.83	
Carrollton	92	52	70.6	3.62	
Catlettsburg	91	42	67.4	3.29	
Earlington	91	49	69.9	8.16	
Edmonton	88	51	69.4	4.61	
Ensor	88	50	68.4	6.31	
Eubank	87	45	67.0	5.95	
Falmouth	......	......	......	3.33	
Fords Ferry	89	48	69.3	4.78	
Frankfort	88	48	68.2	2.10	
Georgetown [c]	88	47	67.7	......	
Greensburg	91	47	69.4	6.16	
Henderson	92	51	70.7	6.89	
Hopkinsville	90	49	69.8	6.61	
Irvington	88	48	68.8	4.70	
Jackstown	88	42	66.6	3.38	
Leitchfield	88	49	68.2	5.01	
Loretto	89	43	68.6	5.22	
Marrowbone	90	47	69.6	4.24	
Maysville	93	42	67.5	3.04	
Middlesboro	91	46	68.6	5.79	
Mount Hermon	86	49	69.1	3.36	
Mount Sterling	89	46	67.2	3.89	
Owensboro	94	49	69.0	5.60	
Owenton	87	42	66.4	4.15	
Paducah *a*	......	......	......	5.72	
Paducah *b*	94	54	72.6	5.79	
Princeton	91	50	69.9	7.01	
Richmond	88	46	67.2	3.68	
St. John	87	47	67.0	4.05	
Scott	87	45	65.8	4.68	
Shelby City	90	45	66.7	4.14	
Shelbyville	92	46	68.8	4.65	
Williamsburg	94	50	71.6	5.90	
Louisiana.					
Abbeville	91	65	77.8	0.35	
Alexandria	95	60	78.3	0.01	
Amite	97	57	78.4	0.05	
Bastrop	95	58	77.8	2.93	
Baton Rouge	94	59	78.2	......	
Calhoun	93	56	76.8	1.36	
Cheneyville	96	51	76.4	0.23	
Clinton	94	58	77.7	0.10	
Como	......	......	......	0.00	
Covington	95	58	77.7	0.07	
Donaldsonville	94	60	77.9	0.05	
Elm Hall	91	57	77.7	0.40	
Emilie	92	57	76.6	0.42	
Farmerville	90	60	75.9	2.08	
Franklin	95	63	79.0	0.02	
Grand Coteau	96	61	78.7	0.72	
Hammond	98	55	77.7	0.32	
Houma	94	62	80.2	1.50	
Jeanerette	96	59	77.4	1.20	
Jennings	93	63	76.9	4.15	
Lafayette	96	62	78.2	0.43	
Lake Charles	90	63	76.4	0.00	
Lake Providence	......	......	......	5.32	
L'Argent	92	62	79.0	0.04	
Lawrence	97	65	80.4	0.33	
Liberty Hill	100	59	78.6	0.65	
Mansfield	94	49	76.5	1.71	
Melville	......	......	......	T.	
Minden	98	60	76.5	1.91	
Monroe	92	61	77.2	1.46	
Montgomery	95	60	78.0	0.35	
New Iberia	92[d]	64[d]	78.2[d]	T.	
Oakridge	94	58	77.4	3.04	
Opelousas	93	61	77.1	0.25	
Paincourtville	94	59	78.6	1.52	
Plain Dealing	92	57	75.2	5.84	
Plaquemine	96	50	77.4	0.32	
Rayne	96	61	77.4	2.70	
Robeline	94	58	76.1	0.51	
Ruston	94	57	77.0	0.74	
Schriever	94	57	76.8	0.19	
Shellbeach	98	67	81.0	......	
Sugar Ex. Station	93	63	78.4	0.05	
Sugartown	92	65	79.9	0.14	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Louisiana—Cont'd.	°	°	°	*Ins.*	*Ins.*
Venice	88	69	78.6	T.	
Wallace	96	59	78.8	0.22	
White Sulphur Springs	95	63	79.2	T.	
Maine.					
Bar Harbor	78	28	51.2	2.25	
Belfast *[6]	78	40	54.4	2.25	
Calais	80	26	51.1	3.89	T.
Cornish *[1]	87	40	55.8	1.05	
Cumberland Mills	88	31	56.2	0.79	
Fairfield	84	32	53.9	2.05	
Farmington	82	25	54.0	1.97	
Flagstaff	76	22	50.6	1.95	
Gardiner	89	33	55.9	1.87	
Kineo	74	30	50.4	3.20	
Lewiston	84	31	55.8	1.14	
Mayfield	80	30	51.8	3.02	
North Bridgton	87	29	56.2	0.80	
Orono	80	26	52.4	4.12	
Petit Menan *[1]	65	42	49.8	......	
Winslow	84	29	54.2	2.32	
Maryland.					
Annapolis	90	44	65.8	3.60	
Bachmans Valley [d]	90	36	62.2	6.05	
Boettcherville	94	37	64.6	4.94	
Boonsboro *a*	93	40	64.4	5.35	
Boonsboro *b*	90	42	64.1	4.78	
Cambridge [c]	91	46	65.2	3.85	
Charlotte Hall	92	36	64.7	3.21	
Chase	90	35	62.6	2.84	
Chestertown	87	43	63.0	2.81	
Chewsville	96	37	63.6	5.08	
Clear Spring	90[c]	42[c]	63.2[c]	4.28	
Coleman	89	42	63.4	2.28	
Collegepark	92	39	64.0	4.22	
Cumberland	90	44	66.1	4.79	
Darlington	88	42	62.6	3.30	
Deerpark	82	31	57.3	6.44	
Easton	89	40	62.8	2.09	
Ellicott City	87	40	62.1	3.28	
Fallston	85	42	61.2	2.83	
Frederick	92	41	64.4	3.71	
Frostburg	85	39	62.0	5.95	
Grantsville	88	31	58.9	6.73	
Greatfalls	90	40	63.8	2.42	
Greenspring Furnace	90	39	63.6	5.75	
Hancock	95	37	64.3	3.61	
Harney	......	......	......	4.69	
Jewell	90	42	63.4	2.45	
Johns Hopkins Hospital	90	43	63.8	3.64	
Laurel	94	39	65.9	3.16	
Mardela Springs	88	38	62.8	3.33	
Mount St. Marys Coll.	89	45	63.8	4.53	
New Market	91	41	64.3	4.22	
Pokomoke City	89	41	63.9	1.74	
Princess Anne	86	36	61.5	1.51	
Prince Fredericktown	90	41	64.7	......	
Queenstown [f]	89	39	63.5	2.15	
Rockhall *b*	89	41	63.4	2.57	
Sandy Point	95	40	64.8	2.64	
Sharpsburg	90	43	64.2	4.55	
Smithsburg *a*	89	40	62.8	4.22	
Smithsburg *b*	89	40	63.6	5.43	
Solomons	89	47	65.4	2.44	
Sudlersville	89	42	63.0	......	
Sunnyside	......	34	......	6.82	
Takoma Park	92	42	64.6	3.82	
Taneytown	90	39	63.6	3.65	
Van Bibber	87	43	62.4	2.97	
Westernport	86	40	62.2	6.62	
Westminster	89	40	61.6	......	
Woodstock	89	40	63.0	3.41	
Massachusetts.					
Adams	81	32	56.8	......	
Amherst	86	33	57.2	0.99	
Attleboro	......	......	......	1.95	
Bedford	91	30	56.8	1.22	
Bluehill (summit)	87	37	56.0	1.11	
Cambridge	90	34	58.4	1.46	
Chestnut Hill	90	31	58.5	0.91	
Cohasset	......	......	......	1.16	
Concord	90	29	56.6	0.97	
Dudley [1]	82*	35	53.9[d]	3.42	
East Templeton *[1]	90	40	56.4	1.38	
Fallriver	80	37	57.6	1.90	
Fiskdale	......	......	......	1.34	
Fitchburg *a* *[1]	86	40	57.3	1.38	
Fitchburg *b*	91	32	57.8	1.12	
Framingham	89	33	58.6	1.38	
Groton	88	29	56.5	2.00	
Hyannis *[1]	76	38	53.8	0.91	
Jefferson	......	......	......	1.38	
Lawrence	90	32	57.8	1.02	
Leeds	89	31	57.5	1.61	
Leicester Hill	88	32	57.4	0.63	
Leominster	......	......	......	1.54	
Long Plain	......	......	......	1.65	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean	Precipitation. Rain and melted snow.	Total depth of snow.
Massachusetts—Cont'd.	°	°	°	*Ins.*	*Ins.*
Middleboro	81	27	55.6	1.52	
Monson	88	32	57.4	1.58	
New Bedford *a*	78	36	55.2	1.21	
New Bedford *b*	81	33	53.9	1.54	
New Salem	81	33	55.8	1.68	
Pittsfield	83	36	56.6	2.51	
Plymouth *[1]	84	35	53.7	1.08	
Princeton	......	......	......	1.41	
Provincetown	81	35	56.2	1.06	
Salem	......	......	......	1.33	
Somerset *[1]	86	32	60.9	2.34	
South Clinton	......	......	......	1.64	
Springfield Armory	88	33	60.4	1.78	
Sterling	......	......	......	0.99	
Taunton *c*	80	27	54.8	2.17	
Webster	......	......	......	1.51	
Westboro	93	30	58.7	1.34	
Weston	88	31	56.6	1.18	
Williamstown	83	34	55.8	1.06	
Winchendon	......	......	......	1.39	
Worcester *a*	85	37	54.0	0.93	
Worcester *b*	90	37	59.2	1.25	
Michigan.					
Adrian	87	37	60.4	5.57	
Agricultural College	83	34	58.8	3.59	
Alma	83	35	58.8	2.88	
Ann Arbor	86	35	60.2	4.35	
Arbela	81	32	56.8	5.40	
Badaxe	84	31	57.1	3.96	
Baldwin	80	29	56.6	2.38	
Ball Mountain	83	34	59.2	2.33	
Baraga	85	......	......	3.67	
Battlecreek	86	36	61.2	4.10	
Bay City	82	35	57.4	4.72	
Berlin	82	31	56.8	2.46	
Berrien Springs	85	36	61.2	5.81	
Big Point Sable *[10]	76	40	51.7	......	
Big Rapids	79	32	56.2	2.63	
Birmingham	85	37	60.6	2.77	
Boon	77	25	52.4	3.34	
Calumet	74	29	48.0	7.52	
Camden	84	36	60.4	4.54	
Carsonville	80	31	56.2	3.17	
Charlevoix	81	28	52.7	3.04	
Cheboygan	85	26	54.8	2.50	
Clinton	91	36	61.0	4.01	
Coldwater	86	37	60.6	7.51	
East Tawas	81	29	52.8	1.05	
Eloise	88	......	......	3.33	
Ewen	81	20	51.0	7.20	
Fairview	81	38	61.0	2.27	
Fitchburg	83	33	58.8	3.91	
Flint	89	30	58.6	4.38	
Gladwin	82	31	56.3	4.55	
Grand Rapids	88	35	60.7	3.83	
Grape	86	37	61.2	3.90	
Grayling	82	18	54.1	1.50	
Hanover	83	35	59.2	4.79	
Harrison	81	31	55.6	4.06	
Harrisville	83	27	52.2	2.40	
Hart	78	32	56.9	2.84	
Hastings	83	33	60.0	4.14	
Hayes	89	30	57.6	2.66	
Highland Station	......	......	......	3.30	
Hillsdale	85	35	59.6	6.65	
Holland *[10]	81	41	58.4	......	
Howell	87	34	60.6	......	
Humboldt	80	19	47.8	3.38	
Ionia	......	......	......	4.02	
Iron Mountain	83	28	53.4	3.95	
Ishpeming	80	26	50.4	4.49	
Ivan	81	27	55.4	1.32	
Jackson	87	37	61.8	4.51	
Jeddo	82	36	56.9	4.47	
Kalamazoo	86	36	61.0	5.31	
Lake City	82	27	54.8	1.40	
Lansing	82	36	59.1	3.28	
Lapeer	84	26	57.6	3.45	
Lathrop	75	22	47.7	5.20	
Ludington	77	32	55.3	1.83	
Luzerne	82	26	54.0	2.77	
Mackinaw	79	28	49.2	6.36	
Madison	88	38	62.1	3.80	
Mancelona	86	22	54.3	1.89	
Manistique	75	28	48.4	5.22	
Menominee	82	32	52.8	......	
Middle Island *[10]	75	37	50.9	......	
Midland	......	......	......	1.90	
Mottville	84	35	60.0	4.11	
Mount Clemens	85	33	60.0	2.02	
Mount Pleasant	82	35	57.6	3.59	
Muskegon	76	39	57.9	3.97	
Newberry	88	20	52.0	1.64	
North Manitou Island *[10]	73	28	51.4	......	
North Marshall	85	34	59.2	3.82	
Northport	78	30	52.7	2.02	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Michigan—Cont'd.	°	°	°	*Ins.*	*Ins.*
Old Mission	82	30	55.3	2.67	
Olivet	80	37	59.4	4.22	
Omer	82	30	52.4	3.80	
Ovid	82	34	59.0	3.97	
Plymouth	85	28	56.4	4.01	
Port Austin [4]	85	35	54.8	3.25	
Reed City	80	28	55.0	2.58	
Rogers	85	25	51.2	4.59	
Romeo	85	36	59.6	2.95	
Saginaw	84	34	59.0	3.52	
St. Ignace	76	29	51.6	2.38	
St. Johns	82	35	60.0	3.95	
St. Joseph	82	40	59.2	4.86	
Sandbeach	84	31	53.2	3.22	
Sidnaw	81	22	49.9	3.45	
Somerset	82	36	58.8	4.47	
South Haven	80	31	57.0	3.91	
Stanton [2]	80	33	58.6	2.32	
Thomaston	86	26	54.5	......	
Thornville	82	35	59.6	2.84	
Thunder Bay Island *[10]	70	36	48.7	......	
Traverse City	85	31	55.4	1.42	
Valley Center	83	31	54.0	3.88	
Vandalia	83	37	61.1	6.57	
Vassar	82	34	57.4	3.94	
Vermillion Point *[10]	80	32	48.4	......	
Wasepi	86	36	60.5	4.75	
Waverly	81	32	57.6	3.68	
Wetmore	81	20	48.8	4.31	
White Cloud	79	30	57.8	3.12	
Ypsilanti	83	36	59.3	4.45	
Minnesota.					
Ada *	83	24	54.2	5.27	
Albert Lea	81	33	57.8	4.95	
Alexandria	89	30	55.0	5.60	
Ashby	83	29	53.5	5.12	
Beardsley	87	28	55.4	4.62	
Bermidji	81	25	51.2	5.05	
Bird Island	85	28	56.0	1.87	T.
Blooming Prairie	83	28	58.0	3.45	T.
Brainerd	82	22	53.4	4.92	
Caledonia	82	33	57.2	4.62	
Camden	85	30	56.0	2.17	T.
Campbell	90	28	55.0	5.52	
Collegeville	82	34	55.0	4.67	
Crookston	79	25	52.6	5.16	
Deephaven	......	......	......	3.99	
Detroit City	80	27	51.4	6.56	T.
Farmington	83	29	57.4	1.81	T.
Fergus Falls	82	27	54.2	5.73	
Glenwood	87	30	57.4	7.63	
Grand Meadow	81	28	56.7	5.27	
Granite Falls	87	28	55.1	5.39	
Hallock	80	22	51.4	......	
Lake City	84	33	58.2	3.27	
Lake Jennie	91	31	56.0	1.51	
Lakeside	84	28	56.6	1.63	
Lake Winnibigoshish [1]	77	32*	50.2	5.08	
Leech Lake	84	26	51.9	5.97	
Leroy	84	31	58.0	......	
Long Prairie	82	29	53.4	4.78	
Luverne	84	32	56.4	4.62	
Lynd	84	28	56.6	5.47	
Mapleplain *[1]	85	33	57.2	3.38	
Milaca	84	30	54.7	3.91	
Milan	90	28	56.3	4.26	
Minneapolis *a*	86	33	58.0	3.52	
Minneapolis *b* [1]	80*	32	57.1	3.35	
Minnesota City *[1]	87	40	62.5	3.35	
Montevideo	90	27	57.0	6.86	
Morris	88	30	55.2	5.50	
Mount Iron	80	20	48.6	5.79	T.
Newfolden	78	22	49.8	2.89	
New London	85	30	54.5	3.83	
New Richland *[1]	82	36	57.4	......	
New Ulm	85	32	57.6	1.69	
Park Rapids	78	27	50.6	7.99	
Pine River	79	26	50.6	4.66	
Pipestone	82	30	55.3	4.91	0.5
Pleasant Mounds	84	31	58.0	4.14	T.
Pokegama Falls	78	21	49.7	7.21	
Redwing	......	......	......	4.16	
Reeds	......	......	......	5.88	
Rolling Green	81	33	57.4	4.50	
Roseau [f]	78	22	48.0	1.74	
St. Charles	82	32	57.8	2.99	
St. Cloud	84	34	54.8	3.79	
St. Peter	80	32	58.7	3.10	
Sandy Lake Dam	77	29	49.9	5.12	
Shakopee	84	32	58.9	2.61	
Tower	77	20	51.2	3.20	1.0
Two Harbors	75	27	45.9	5.72	
Wabasha *[1]	83	41	59.7	5.69	
Willmar	86	30	54.8	4.12	
Willow River	83	28	51.0	5.70	
Winnebago City	86	30	57.6	6.14	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Minnesota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Worthington	81	30	55.9	5.29	
Zumbrota [1]	86*	35	58.7	......	
Mississippi.					
Aberdeen	95	56	75.0	1.48	
Agricultural College	91	59	76.5	4.93	
Americus	96	58	78.4	0.81	
Austin	91	56	74.0	3.54	
Batesville	93	55	73.9	1.96	
Bay St. Louis	91	67	79.4	0.04	
Biloxi	87	62	76.8	T.	
Booneville	92	54	72.6	0.79	
Briers	91	63	78.2	T.	
Brookhaven	101	58	80.4	0.65	
Canton	93	58	76.4	3.26	
Columbus *a*	......	......	......	4.56	
Columbus *b*	92	55	76.6	3.45	
Corinth	90	54	73.2	0.69	
Crystal Springs	97	57	78.6	0.37	
Edwards	99	62	80.0	1.08	
Fayette	......	59	......	T.	
Fayette (near) *[1]	96	66	81.4	......	
Greenville *a*	89	61	75.6	4.67	
Greenville *b*	91	62	76.8	4.67	
Greenwood [b]	91	56	76.5	5.61	
Hattiesburg	94	61	80.2	0.38	
Hazlehurst	93	59	77.8	0.24	
Hernando	92	56	74.0	2.74	
Holly Springs	93	58	74.5	1.65	
Jackson	96	59	77.9	0.85	
Kosciusko	91	59	76.2	2.66	
Lake	99	55	75.2	3.65	
Leakesville	98	55	78.4	2.96	
Logtown	93	60	78.5	0.06	
Louisville	92	53	74.3	1.93	
Macon	96	58	78.8	2.32	
Magnolia	97	58	79.8	0.30	
Moss Point	96	70	82.2	......	
Natchez	95	55	79.0	0.00	
Okolona	98	50	75.4	1.69	
Palo Alto	93	59	77.1	2.46	
Pontotoc	91	57	74.7	1.30	
Port Gibson	96	58	78.0	0.04	
Stonington *[1]	92	66	79.6	T.	
Thornton	......	......	......	5.90	
Tupelo	......	......	......	0.97	
University	93	56	74.0	3.25	
Water Valley *[1]	91	60	74.0	3.81	
Waynesboro	95	55	76.7	1.00	
Windham	98	53	77.4	1.53	
Woodville	95	58	78.4	T.	
Yazoo City	99	61	79.4	3.91	
Missouri.					
Appleton City	91	44	69.3	5.44	
Arlington	......	......	......	4.78	
Arthur *[3]	......	50	68.1	5.13	
Avalon	86	45	65.4	3.56	
Bagnell	......	......	......	6.20	
Bethany	87	38	63.4	7.73	
Birchtree	88	47	68.4	7.63	
Boonville	......	......	......	5.65	
Brunswick	88	44	65.5	7.51	
Carrollton	87	47	67.0	9.26	
Conception	85	42	64.2	6.57	
Cook Station	90	40	68.4	4.45	
Cowgill *[5]	87	48	66.6	5.71	
Darksville	92	45	66.2	9.85	
East Lynne *[3]	......	43	63.0	3.15	
Edgehill *[5]	88	52	70.2	5.21	
Eightmile *[1]	86	44	65.0	3.08	
Eldon	89	43	67.1	6.39	
Elmira	88	34	65.3	4.80	
Fairport	......	......	......	5.62	
Fayette	86	45	65.2	6.20	
Fulton	......	......	......	4.34	
Galena	......	......	......	8.95	
Gallatin *[1]	88	44	65.4	5.94	
Gayoso	95	54	73.7	5.10	
Glasgow	90	43	66.0	8.73	
Gorin	......	......	......	7.84	
Halfway	89	47	68.4	6.06	
Harrisonville	88	40	66.5	4.00	
Hazlehurst	......	......	......	6.00	
Hermann	......	......	......	4.13	
Houston	88	44	69.1	4.61	
Houstonia (near)	......	......	......	5.51	
Irena	......	......	......	8.59	
Ironton	89	41	67.9	5.65	
Jackson *[3]	87	54	66.9	4.21	
Jefferson City	96	45	68.2	5.04	
Kidder	86	42	64.4	5.50	
Lamar	90	47	69.9	4.73	
Lamonte	......	......	......	5.26	
Lebanon	89	50	69.4	6.15	
Lexington	89	40	67.6	6.02	
Liberty	86	40	64.0	3.24	
Louisiana	88	41	65.5	8.77	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Missouri—Cont'd.	°	°	°	*Ins.*	*Ins.*
McCune *1	89	46	66.2	8.67	
Marblehill	88	44	68.1	5.46	
Marshall	86	42	65.1	6.13	
Maryville	86	41	61.8	9.31	
Mexico	93	42	67.1	7.47	
Miami *5	88	47	67.4	8.60	
Mineralspring	88	44	67.9	7.85	
Montreal	88	44	67.5	5.49	
Mount Vernon	91	46	70.1	8.23	
Neosho	89	41	69.1	8.08	
Nevada*	88	42		3.62	
New Haven	90	47	68.0	4.63	
New Madrid*	93	43		3.62	
New Palestine	86	45	66.5	5.16	
Oakfield	88	47	67.2	5.87	
Olden	84	47	67.0	5.62	
Oregon *a*	88	42	65.7	5.13	
Oregon *b*	88	45	67.3	4.85	
Palmyra *5	86	45	65.9	9.27	
Phillipsburg *1	89	54	68.0	5.16	
Pickering *3		40	59.7	8.85	
Poplarbluff	93	49	71.4	6.33	
Potosi	90	39	66.4	4.17	
Princeton	91	41	63.4	7.59	
Rhineland	91	43	67.5	5.31	
Richmond	86	46	67.6	4.37	
Rolla				3.78	
St. Charles	88	49	66.6	5.06	
St. Joseph				3.66	
Sarcoxie *3		46	67.0	4.08	
Sedalia	88	41	66.4	4.96	
Seymour	86	46	67.2	6.23	
Shelbina				6.90	
Sikeston	90	49	69.8	4.76	
Steffenville	86	43	64.9	8.22	
Stellada	87	42	67.4	5.60	
Sublett	86	40	62.6	11.38	
Trenton	86	40	64.6	5.42	
Unionville	88	40	64.8	8.35	
Vichy	95	45	68.3	6.48	
Warrensburg	89	42	67.4	8.26	
Warrenton	89	46	66.6	7.00	
Wheatland				6.64	
Willow Springs	90	49	69.2	8.90	
Wylie	90	49	70.2	9.22	
Zeitonia	90	44	69.4	3.95	
Montana.					
Adel	71	7	42.5	2.01	10.0
Billings	84	28	53.8	3.50	8.0
Butte	73	24	44.8	2.46	
Canyon Ferry	78	26	52.0	1.08	
Castle	64	12	41.4	1.86	
Chinook	83	13	48.4	5.34	24.0
Corvallis	80	28	51.6	0.14	
Crow Agency	83	27	53.4	2.23	10.0
Dearborn Canyon	69	16	44.8	2.05	
Deer Lodge	79	19	47.0		
Dell	72	14	42.8	0.89	
Ekalaka	80	20	49.2	3.12	1.7
Fort Benton	78	16	47.4	3.90	9.0
Fort Keogh	80	26	52.7	2.85	
Fort Logan	78	10	45.6	0.67	3.0
Glasgow	74	22	47.3	5.69	
Glendive	86	23	52.9	2.65	7.0
Glenwood	81	21	46.4	1.46	
Greatfalls	73	21	49.6	3.12	4.8
Kipp	75	15	43.3	3.69	8.5
Manhattan	80	20	48.6	0.18	T.
Martinsdale	73	20	45.4	3.23	8.0
Marysville	70	19	43.6	1.87	2.5
Missoula	82	28	49.1	1.58	T.
Parrot	76	24	48.0	2.12	2.5
Plains	80	20	48.6		
Poplar	76	22	51.0	3.25	9.0
Redlodge	71	20	45.2	1.10	11.0
Ridge	84	20	49.8	4.11	
St. Ignatius	74	26	49.1	2.83	T.
St. Pauls	75	10	46.9	6.19	3.3
Shelby	78	16	48.4	2.05	2.0
Troy	83	23	49.2	2.31	T.
Utica	77	17	44.9	3.33	14.0
Yale	73	16	45.0	2.13	T.
Nebraska.					
Agee *1	92	35	58.3	3.00	
Albion	89	30	59.2	4.50	
Alliance				3.45	
Alma *1	90	36	61.8	2.01	
Ansley	88	30	58.8	2.12	
Arapaho *1	90	44	64.5	0.90	
Arborville				6.60	
Ashland *a*	89	38	62.6	4.34	
Ashland *b* *1	90	48	64.4	3.97	
Ashton	89	36	60.4	2.82	
Auburn	90	36	65.0	5.54	
Aurora *1	90	40	61.8	3.53	
Bartley				1.79	
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*
Bassett				5.54	
Beatrice	88	35	62.6	5.50	
Beaver City	93	31	63.8	1.28	
Bellevue				5.54	
Benedict				3.54	
Benkleman				1.25	
Blair	87	34	60.2	5.21	
Bluehill				3.40	
Bradshaw				5.19	
Brokenbow				3.08	
Burchard				3.94	
Burwell				2.97	
Callaway	89	35	58.2	2.21	
Camp Clarke	93	21	56.0	2.75	
Central City				5.12	
Chester				4.91	
Clatonia				3.36	
Columbus	89	38	60.4	5.19	
Creighton	91	30	58.8	4.32	
Crete	88	37	63.2	2.71	
Culbertson				1.93	
David City	89	44	63.6		
Dawson	90	36	65.8	4.67	
Eden				6.63	
Edgar *a*				2.89	
Elba				4.36	
Ericson *1	89	34	61.4	3.91	
Ewing				3.05	
Fairbury	95	32	64.4	4.60	
Fairfield				3.10	
Fairmont	94	32	60.8	3.19	
Fort Robinson	88	26	53.1	3.00	
Franklin	94	33	64.6	5.96	
Fremont	85	35	60.6	6.90	
Geneva	90	35	62.6	2.57	
Genoa	88	39	60.6	5.54	
Gering	83	27	54.2	7.72	
Gordon				5.25	
Gothenburg				4.01	
Grand Island *a*				5.39	
Grand Island *b*	91	36	61.8	4.99	
Grand Island *c*	91	34	61.7	4.33	
Greeley				3.40	
Haigler				2.13	
Hartington	88	30	57.4	7.63	
Harvard	89	35	61.6	2.98	
Hastings *1	89	38	61.8	2.26	
Hayes Center				3.24	
Hay Springs	87	25	52.8	2.82	
Hebron	93	32	62.7	4.05	
Hickman				3.82	
Holdrege *b*				7.25	
Hooper *1	86	44	64.2	3.74	
Hubbard				5.15	
Imperial	86	29	59.6	2.44	
Johnstown				4.75	
Kearney				4.77	
Kennedy	88	30	57.4	1.73	
Kimball	86	22	54.5	3.67	
Kirkwood *1	90	35	57.0	3.63	
Lexington	91	33	61.0	2.66	
Lincoln *b*	89	41	62.4	2.62	
Lincoln *d*	89	43	63.8	2.97	
Lodgepole	86	23	56.2	1.25	
Loup *b* *1	88	38	59.1	2.47	
Lynch	100	32	61.2	3.96	
Lyons				5.94	
McCook				1.57	
McCool				2.48	
Madison	89	33	58.6	5.93	
Madrid *5	85	27	57.9	2.75	
Marquette				4.37	
Merriman				3.00	
Minden *a*	91	33	61.7	2.83	
Minden *b*				2.59	
Monroe				4.18	
Nebraska City *b*				6.44	
Nebraska City *c*	87	40	63.6	6.08	
Nemaha *1	94	44	64.6	6.71	
Nesbit	84	23	56.8	5.47	
Norfolk *b*	88	34	59.4	8.30	
North Loup	90	33	59.6	2.81	
Oakdale	90	34	59.5	5.47	
Odell				5.40	
O'Neill	90	31	57.8	3.40	
Ord				2.62	
Osceola				4.54	
Ough				1.44	
Oxford	96	32	67.5		
Palmer *b*				3.99	
Palmyra				5.20	
Paxton				2.57	
Plattsmouth *a*				5.40	
Plattsmouth *b*				5.13	
Pleasant Hill				3.41	
Ravenna *a*	89	23	60.0	1.98	
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*
Redcloud *a*				2.94	
Redcloud *b* *1				2.57	
Republican *1	88	40	62.5	3.18	
Rulo				4.30	
St. Libory				2.48	
St. Paul				2.77	
Salem *1	86	48	66.0	5.25	
Santee Agency	93	36	60.9	2.47	
Sargent				1.83	
Schuyler				5.95	
Seneca *1	74	36	51.6	0.15	
Seward *1	85	45	62.4	3.59	
Spragg				3.42	
Springview	88	30	56.2	4.21	
Stanton				6.07	
State Farm	90	37	63.4	2.32	
Strang *1	84	42	63.3	3.18	
Stratton				1.61	
Superior *5	90	38	66.6	3.10	
Syracuse				4.94	
Tablerock				5.47	
Tecumseh *b*	90	37	63.0	4.79	
Tecumseh *c*				5.12	
Tekamah	88	35	60.4	4.00	
Thedford				2.95	
Turlington	88	41	62.1	4.89	
Valentine	87	32	56.8	2.84	
Valparaiso				4.16	
Wakefield	87	32	60.0	5.74	
Wallace				4.65	
Wauneta				1.62	
Weeping Water *1	85	35	59.8	3.74	
Wellfleet	86	34	61.6	5.33	
Westpoint	85	35	62.0	5.55	
Whitman				1.95	
Wilber *1	90	44	65.6	3.40	
Willard				4.63	
Wilsonville *1	88	34	63.4	1.95	
Wisner				4.18	
Wymore *1	88	46	65.7	5.34	
York *1	92	42	61.2	2.69	
Nevada.					
Battle Mountain *1	78	30	52.6	0.50	
Beowawe *1	83	26	49.0		
Bunkerville				0.25	
Candelaria	83	21	50.2		
Carlin *1	74	28	47.0	1.15	
Carson City	81	23	48.6	0.52	0.9
Clover Valley				0.92	3.0
Cranes Ranch				1.06	
Elko (near)				0.42	0.2
Ely	79	15	47.5	1.95	14.0
Empire Ranch	89	10	46.2	0.62	6.0
Fenelon				1.75	9.0
Golconda *1	68	28	48.4	1.38	4.0
Halleck *1	82	26	46.2	0.20	2.0
Hawthorne *b*	84	27	52.4	0.09	T.
Hot Springs				T.	
Humboldt *1	84	35	53.4	0.44	1.0
Lee				1.62	6.5
Lewers Ranch	79	16	47.6	1.03	2.1
Los Vegas	89	35	58.8	0.00	
Lovelocks *1	77	36	52.2	0.15	
Martins		24		0.50	
Mill City	80	30	51.8	0.90	
Monitor Mill	76	14	46.8	0.96	5.8
Palisade *1	81	32	55.7	1.10	1.0
Palmetto	82	12	46.4	0.63	
Reno State University	80	25	49.7	0.41	1.5
St. Clair	82	24	51.1	0.36	2.0
Silverpeak	89	22	56.4	0.50	
Sodaville	85 *c*	24	55.6 *c*	0.20	
Tecoma *1	80	30	46.7	0.05	0.5
Tybo	82	24	50.3	0.80	
Verdi *1	96	30	51.7	1.09	T.
Wadsworth *1	84	30	50.5	0.42	T.
Wells	76	13	45.6	1.50	
New Hampshire.					
Alstead *6	84	34	58.0	1.31	
Berlin Mills	83	24	52.0	1.92	
Bethlehem	82	28	54.1	1.77	T.
Brookline *1	92	28	58.3	1.83	
Claremont	94	26	57.9	1.20	
Concord	88	28	55.6	0.32	
Durham	87	28	55.0	1.08	
Grafton	86	22	52.5	0.92	
Hanover	87	28	55.1	0.93	
Keene	89	28	55.8	2.39	
Littleton	85	33	55.6	1.16	T.
Nashua	91	29	57.8	1.91	
Newton	89	25	54.6	1.25	
North Conway	88	28	55.7	1.28	
Peterboro	86	26	54.8	1.41	
Plymouth	90	26	54.6	1.17	
Sanbornton	86	29	54.4	1.22	
Stratford	82	25	55.9	1.38	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
New Hampshire—Cont'd	°	°	°	*Ins.*	*Ins.*
Warner				1.68	
New Jersey.					
Asbury Park	87	41	59.1	1.84	
Barnegat				1.15	
Bayonne	91	42	62.4	1.52	
Belvidere	89	35	60.4	2.76	
Bergen Point	87	46	61.8	2.17	
Beverly	93	39	62.8	2.02	
Billingsport *[1]	88	49	62.8	1.90	
Boonton	87	34	59.2	1.45	
Bridgeton	94	39	64.2	2.41	
Camden	88	42	62.0	1.82	
Cape May C. H.	90	38	60.7	2.06	
Charlotteburg	87	29	58.4	2.26	
Chester	85	34	58.6	3.15	
Clayton	92	39	62.0	1.69	
College Farm	90	38	61.8	2.25	
Deckertown	89	38	60.8	1.88	
Dover	90	35	60.4	2.21	
Egg Harbor City	94	35	60.8	1.26	
Elizabeth	93	43	63.0	1.60	
Englewood	89	39	60.2	1.95	
Flemington	91	35	61.5	2.27	
Freehold	86	39	60.3	2.10	
Friesburg	90	38	62.0	2.19	
Hammonton				1.56	
Hanover	86	39	61.5	2.18	
Hightstown	90	39	62.6	2.12	
Imlaystown	93	39	63.8	1.57	
Lebanon				2.58	
Moorestown	91	38	61.8	2.37	
Mount Pleasant				1.45	
Newark	89	42	61.2	1.63	
New Brunswick	92	39	63.2	2.27	
Newton	91	39	60.0	2.75	
Ocean City	88	37	57.6	1.70	
Oceanic	85	42	60.2	2.04	
Paterson	94	42	63.8	1.61	
Perth Amboy	92	43	62.8	1.94	
Plainfield	89	38	60.0	2.21	
Rancocas				1.86	
Rivervale	90	35	60.0	2.04	
Roseland	88	36	59.7	1.65	
Salem	91	38	63.2	2.12	
Somerville	93	37	62.3	2.43	
South Orange	88	41	61.2	1.62	
Toms River	92	34	60.0	1.79	
Trenton	87	40	62.6	1.81	
Tuckerton	91	36	60.1	1.19	
Vineland	94	38	62.7	1.54	
Woodbine	88	37	60.4	2.10	
New Mexico.					
Albert	94	32	67.6	0.60	
Albuquerque	92	30	63.8	0.00	
Alma	92	27	59.4	T.	
Aztec	85	18	54.6	0.05	0.5
Bernalillo	92	25	62.2	0.00	
Bluewater	89	14	53.7	T.	T.
Cambray				0.00	
Clayton	86	26	60.8	0.53	
East Lasvegas	85	26	57.8	0.40	
Eddy	104	38	72.6	T.	
Engle	91	26	61.8	0.00	
Espanola	88	27	58.3	0.00	
Folsom	87	23	58.2	0.53	
Fort Bayard	86	29	58.2	T.	
Fort Union	85	22	51.9	T.	T.
Fort Wingate	81	11	54.0	0.10	
Galisteo	88	21	60.3	0.00	
Gallinas Spring	94	29	62.8	0.01	
Gila	93	22	63.4	T.	
Hillsboro	95	31	64.8	0.00	
Las Vegas Hotsprings	85	29	57.9	0.22	
Los Lunas	86	29	59.1	0.00	
Lower Penasco	89	30	63.2	0.00	
Mesilla Park	93	27[f]	62.4[f]	T.	
Monero	85	11	48.0	0.05	
Olio	87	18	56.8	0.00	
Puerto de Luna	97	31	66.0	0.00	
Raton	83	22	58.1	0.56	
Rincon	95			0.00	
Roswell	98	33	67.4	0.27	
San Marcial	93	27	63.8	T.	
Shattucks Ranch	95	30	65.5	T.	
Socorro	95	33	65.4	0.04	
Springer	91	18	60.0	0.50	
White Oaks	85	26	59.4	0.00	
Winsors Ranch	78	14	46.0	0.15	
New York.					
Adams				2.73	
Addison	86	33	58.2	2.88	
Akron				2.10	
Alfred	84	34	55.5	3.07	
Angelica	85	31	56.6	2.39	
Appleton	84	34	55.6	2.88	
Arcade	85	33	56.0	4.92	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
New York—Cont'd.	°	°	°	*Ins.*	*Ins.*
Atlanta				2.85	
Auburn	90	31	59.3	3.53	
Avon	86	31	57.6	2.62	
Baldwinsville	88	34	58.5	3.42	
Bedford	85	33	57.9	2.36	
Bolivar	86	27	55.4	3.60	
Bouckville	86	30	55.3	3.35	
Boyds Corners				1.80	
Brentwood	85	32	57.2	2.20	
Caldwell	84	33	57.2	1.72	
Canajoharie	86	31	56.6	3.33	
Canton	83	32	56.0	3.12	
Carmel	86	38	59.7	1.68	
Carvers Falls	86	28	55.7	1.69	
Catskill	84	38	58.8	2.12	
Cedarhill	92	35	60.6	2.50	
Charlotte *[10]	78	38	54.6		
Chenango Forks				3.00	
Cherry Creek				4.87	
Cooperstown	84	32	55.4	4.52	
Cortland	87	25	57.2	2.50	
Cutchogue	89	35	58.6	1.79	
Dekalb Junction				2.59	
Dryden	86	29	57.1	3.53	
Elizabethtown *[1]	90	30	49.0		
Ellenburg Depot *[1]	84	37	56.9	1.10	
Elmira	86	36	59.8	2.52	
Fayetteville				2.16	
Fleming	88	35	58.5	3.35	
Fort Niagara	82	36	54.2	3.84	
Franklinville	83	29	55.2	3.19	
Fulton				3.78	
Garrattsville	85	29	55.0	2.00	
Glens Falls	88	33	58.7	2.37	
Gloversville	88	33	55.9	3.23	
Greenwich	86[c]	32[c]	56.5[c]	2.48	
Haskinsville				3.58	
Hemlock Lake	82	34	58.6	2.72	
Honeymead Brook	86	35	58.4	1.78	
Hopewell	87	31	56.4	2.10	
Humphrey	83	35	57.2	4.21	
Ithaca	87	33	58.1	2.90	
Jamestown	82	38	58.2	4.76	
Keene Valley	81	26	53.9	1.75	
Kings Station				3.25	
Lake Hill	84	33	55.8	2.65	
Lake Placid	79	27	52.4	0.88	
Liberty				3.33	
Little Falls	87	31	56.0	4.15	
Lockport	84	34	57.9	1.80	
Lowville	85	29	54.9	3.29	
Lyndonville				2.26	
Lyons	87	35	58.2	2.58	
Madison Barracks	84	30	54.8	1.10	
Mayle				3.52	
Middletown	85	41	60.0	1.89	
Milford				3.66	
Mohonk Lake [1]	84*	44	58.2		
Mount Morris	87	30	60.9		
Newark Valley				3.47	
New Lisbon	86	26	53.6	3.44	
North Germantown	84	40	60.4	2.54	
North Hammond	76	36	56.1	3.95	
North Lake	84	25	53.0	3.72	
Number Four	81	28	52.5	3.77	
Nunda	89	34	58.6	4.37	
Ogdensburg	79	39	56.1	1.79	
Oneonta	90	29	56.4	2.79	
Oxford	89	30	57.4	3.43	
Palermo	87	31	55.8	2.47	
Penn Yan	92	32	59.6	2.96	
Perry City	89	29	56.6	2.73	
Phenix				3.69	
Pine City				3.11	
Plattsburg Barracks	82	19	49.7	2.52	
Port Byron	84	34	57.4	2.61	
Port Jervis	91	37	60.8	2.30	
Poughkeepsie	88	33	59.0	1.27	
Primrose	88	36	59.4	3.08	
Red Hook *[1]	90	40	61.6		
Richmondville	90	30	55.8	2.75	
Ridgeway	82	34	56.4	2.52	
Rome	81	28	55.3	3.65	
Romulus	90	33	58.6	2.72	
Rose				2.90	
St. Johnsville	89	31	57.4	3.48	
Saranac Lake	78	31	53.5	1.15	
Saratoga Springs	87	34	56.4	2.15	
Schenectady	86	36	59.4	3.17	
Scottsville				3.42	
Setauket	85	37	58.6	1.95	
Sherwood				2.85	
Skaneateles				4.45	
South Canisteo	87	31	56.2	3.29	
Southeast Reservoir				2.10	
South Kortright	87	24	54.6	2.81	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
New York—Cont'd.	°	°	°	*Ins.*	*Ins.*
Straits Corners	89	32[d]	57.5	3.31	
Volusia	80	36	56.0	5.07	
Wappingers Falls	91	34	60.8	2.24	
Warwick				2.84	
Watertown	88	33	57.1	3.48	T.
Waverly	92	29	58.6	3.26	
Wedgwood	90	32	58.6	2.04	
West Berne	85	42	62.6	3.25	
Westfield *a*	85	38	58.2	4.30	
Westfield *b*	84	37	58.0		
Westfield *c*	86	40	58.8	3.68	
Westpoint	90	41	61.1	2.31	
Willetspoint	88	40	60.1	1.58	
Williamson				3.32	
North Carolina.					
Abshers	93	37	66.8	2.76	
Asheville				1.96	
Biltmore	91	41	67.4	2.46	
Bryson City				5.30	
Chapel Hill	92	44	69.4	4.51	
Currituck Inlet				2.17	
Durham	93	46	72.6	4.90	
Edenton	90	46	68.6	2.58	
Experimental Farm	91	45	69.5	5.11	
Fairbluff				2.88	
Fayetteville	94	44	70.0	2.35	
Flatrock	88	37	65.1	3.47	
Goldsboro	95	46	69.1	4.36	
Greensboro	92	45	68.4	4.45	
Henderson	91	43	68.4	5.01	
Hendersonville	88	39	66.3	3.74	
Highlands	82	39	61.2	3.01	
Horse Cove	89	43	67.3	2.22	
Lenoir *[1]	87	47	67.4	3.07	
Linville	79	33	59.4	2.92	
Littleton	90	42	67.8	2.72	
Louisburg	91	42	69.1	3.01	
Lumberton	95	49	71.2	3.96	
Mana				1.54	
Marion	95	42	69.1	3.34	
Marshall	88	41	68.8	2.93	
Mocksville	93	40	69.6	2.38	
Moncure	90	45	68.8	4.68	
Monroe	95	38	69.6	2.55	
Morganton	96[f]	41[f]	69.6[f]	2.33	
Mountairy	88	41	65.7	3.42	
Mount Pleasant	92	43	70.2	3.19	
Murphy				2.79	
Newbern	94	49	67.6	5.50	
Oakridge	93	41	67.8	3.39	
Pantego				3.65	
Patterson *[1]	88	42	62.4	5.14	
Pittsboro	95	38	68.6	4.91	
Rockingham	96	46	71.4	4.56	
Roxboro	90	36	66.4	3.85	
Salem	93	41	69.4	2.51	
Salisbury	95	45	71.0	3.36	
Saxon	92	39	67.6	3.59	
Selma	96	42	69.8	3.60	
Settle	93	38	67.8	1.79	
Sloan	92	48	70.0	4.98	
Soapstone Mount	92	37	66.4	4.78	
Southern Pines *a*	98	45	71.8	3.02	
Southern Pines *b*	94	45	71.3	2.63	
Southport	87	51	70.4	2.51	
Springhope *[1]	91	46	66.9	2.50	
Tarboro [f]	97	40	68.6	3.63	
Waynesville	87	43	65.1	3.01	
Weldon *a*	89	46	67.6	2.28	
Weldon *b*				2.27	
North Dakota.					
Amenia	85	27	52.6	4.13	
Ashley	84	23	50.7	4.22	T.
Berlin	85	20	49.6	3.31	
Bottineau	75	17	47.2	2.96	T.
Buxton	81	26	51.2	4.73	
Churchs Ferry	79	25	50.4	3.00	
Coal Harbor	79	25	49.3	6.06	T.
Devils Lake	79	25	49.4	2.84	1.1
Dickinson	82	22	49.0	3.51	8.0
Donnybrook	80	20	50.2	1.70	0.5
Dunseith	76	20	49.5	1.75	
Ellendale	87	29	54.6	2.70	
Fargo	84	23	52.5	4.22	
Forman	86	21	53.4	4.44	
Fort Berthold	82	30	48.0	7.74	0.5
Fort Yates	88	23	53.7	5.02	
Fullerton [1]	86*	20	50.5	3.08	T.
Gallatin	81	19	51.2	4.26	0.6
Glenullin	76	20	45.6	1.30	
Grafton	77	24	49.7	1.76	T.
Hamilton	84	21	50.5	3.10	T.
Jamestown	79	23	50.0	2.12	
Kelso	84	26	53.4	4.36	
Langdon	71	21	47.4	4.25	
Larimore	81	24	49.3	2.22	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
North Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Lisbon	85	20	52.3	2.84	
McKinney	89	21	49.6	2.50	0.6
Mayville	......	......	......	4.15	
Medora g	90	22	52.4	......	0.8
Melville	81	20	50.4	4.18	T.
Milton	74	20	49.0	2.70	
Minnewaukon	78	23	50.7	2.48	
Minot	75	24	50.0	5.31	0.3
Napoleon	82	22	50.7	4.15	2.0
New England City	72	24	46.4	2.50	
Oakdale	76	20	49.1	2.37	1.4
Pembina	86	21	52.2	1.29	T.
Portal	76	19	46.6	1.26	1.0
Power	79	16	51.6	2.63	
Sheyenne	......	......	......	3.51	T.
Steele	82	22	51.0	3.67	
Towner	78	21	48.6	6.84	
University	......	......	......	6.11	
Wahpeton	91	22	56.8	5.66	
Washburn	85	22	51.3	4.35	0.2
Willow City	73	26	49.2	2.60	
Woodbridge	79	18	48.8	1.92	T.
Ohio.					
Akron	86	38	61.4	6.32	
Ashland	86	36	63.8	4.50	
Ashtabula	83	38	57.3	6.70	
Atwater	......	......	......	5.54	
Bangorville	88	37	62.6	4.38	
Bellefontaine	87	39	63.2	2.47	
Bement	......	......	......	5.82	
Benton Ridge	87	40	62.7	2.44	
Bethany	91	41	67.6	5.16	
Bigprairie	88	37	61.0	......	
Binola	......	......	......	5.62	
Bladensburg	86	39	61.6	4.15	
Bloomingburg	88	43	64.4	2.23	
Bowling Green	85	38	61.4	3.24	
Bucyrus	92	40	66.4	5.71	
Cambridge	87	34	60.8	4.55	
Camp Dennison	89	45	66.8	4.56	
Canal Dover	88	36	62.3	6.84	
Canton	87	38	63.0	5.52	
Carrolton	88	35	63.2	5.92	
Cedarville	......	......	......	2.49	
Celina	......	38	......	2.94	
Chillicothe	93	43	66.6	3.42	
Circleville	88	42	65.7	3.51	
Clarksville	87	44	65.1	2.65	
Cleveland a	84	43	61.0	4.50	
Cleveland b	85	44	60.8	3.12	
Coalton	89	39	65.6	3.69	
Colebrook	84	34	59.4	3.97	
Dayton a	93	41	65.4	3.64	
Dayton b	......	......	......	2.79	
Defiance	89	38	62.2	3.05	
Delaware	88	38	63.3	2.95	
Demos	87	38	62.8	4.84	
Elyria	88	36	61.2	5.30c	
Findlay	89	40	62.3	3.31	
Frankfort	88	40	65.9	4.55	
Garrettsville	86	33	59.8	6.37	
Granville	89	39	64.0	3.15	
Gratiot	86	40	63.2	3.53	
Greenfield	88c	47c	64.4c	3.10	
Greenhill	85	31	59.8	6.04	
Greenspring	86	42	64.2	5.48	
Greenville	82	42	62.4	2.58	
Hackney	90	39	63.5	3.05	
Hanging Rock	90	41	65.8	5.15	
Hedges	......	......	......	2.37	
Hillhouse	82	32	58.4	7.14	
Hillsboro	87	43	63.8	4.04	
Hiram	83	39	60.8	6.90	
Hudson	86	35	60.7	7.11	
Jacksonboro	88	44	65.6	2.85	
Kenton	88	40	63.5	4.65	
Killbuck	87	39	61.6	4.74	
Lancaster	89	40	64.8	3.72	
Levering	91	35	63.8	4.45	
Logan	96	39	65.8	4.50	
Lordstown	87	35	59.8	5.00	
Lowell	94	38	66.8	4.51	
McArthur	88	38	63.9	2.87	
McConnelsville	91	40	64.7	4.18	
Mansfield	......	......	......	4.60	
Marietta	88	45	66.4	4.15	
Marion	88	39	64.0	3.05	
Medina	88	34	61.2	6.03	
Milfordton	86	35	61.1	3.74	
Milligan	93	35	64.0	3.62	
Millport	90	34	60.8	4.77	
Montpelier	87	38	61.0	3.65	
Napoleon	89	36	61.6	2.68	
Neapolis	......	......	......	5.83	
New Alexandria	84	41	63.4	4.95	
New Berlin	85	37	61.8	6.71	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Ohio—Cont'd.	°	°	°	*Ins.*	*Ins.*
New Holland	90	42	65.4	3.20	
New Paris	84	41	64.4	1.64	
New Richmond	89	44	67.2	4.50	
New Waterford	91	34	62.9	5.69	
North Lewisburg	88	42	64.5	4.20	
North Royalton	87	39	61.7	5.33	
Norwalk	87	37	62.0	6.32	
Oberlin	90	34	62.1	4.44	
Ohio State University	87	39	62.8	3.35	
Orangeville	85	33	59.6	4.16	
Ottawa	87	38	62.8	2.94	
Pataskala	86	39	63.6	3.40	
Perry	......	......	......	6.25	
Philo	91	40	65.0	4.45	
Plattsburg	85	40	65.6	1.83	
Pomeroy	95	41	69.2	2.77	
Portsmouth a	......	......	......	4.78	
Portsmouth b	92	48	68.7	4.95	
Pulse	......	......	......	3.10	
Richwood	89	40	67.2	2.08	
Ridgeville Corners	84	35	60.0	4.10	
Ripley	88	45	66.7	2.92	
Rittman	85	33	58.4	5.01	
Rockyridge	87	39	61.6	5.19	
Rosewood	85	42	63.9	2.67	
Seaman	91	38	64.6	2.91	
Shenandoah	89	35	61.6	4.13	
Sidney	92	43	65.6	3.03	
Sinking Spring	86	45	65.2	3.82	
Somerset	89	42	68.1	3.32	
Springboro	......	......	......	3.38	
Strongsville	......	......	......	5.58	
Sylvania	87	37	59.8	6.20	
Thurman	90	42	66.4	2.66	
Tiffin	88	41	62.0	5.42	
Upper Sandusky	89	39	63.3	5.96	
Urbana	86	43	63.8	3.75	
Vanceburg	90	42	66.8	2.72	
Vermillion	87	36	60.4	5.45	
Vickery	86	38	61.8	5.27	
Walnut	......	......	......	4.98	
Warsaw	93	35	63.2	6.17	
Wauseon	87	36	62.0	4.53	
Waverly	91	44	67.0	4.74	
Waynesville	87	40	63.9	4.17	
Wellington	88	36	62.0	7.06	
Westerville	84	41	63.8	4.67	
Willoughby	......	......	......	4.18	
Wooster	86	28	60.0	4.42	
Zanesville	......	......	......	2.86	
Oklahoma.					
Arapaho	95	46	71.4	4.56	
Beaver	98	41	68.0	1.35	
Burnett	92	44	72.1	9.46	
Clifton	90	40	72.0	7.87	
Edmond	93	49	71.6	7.14	
Fort Reno	86	40	68.7	3.01	
Fort Sill	92	44	72.1	6.68	
Guthrie	91	49	72.8	4.95	
Hennessey	89	43	69.8	5.39	
Hopeton	98	37	69.9	3.48	
Jefferson	......	......	......	5.53	
Kingfisher	89	42	70.4	5.37	
Mangum	94	40	67.6	5.18	
Newkirk	90	44	69.2	5.82	
Norman	91	44	71.6	7.09	
Pawhuska	91	40	70.4	12.30	
Perry	90	41	70.2	6.38	
Prudence	94	45	70.4	5.46	
Putnam	......	40	......	4.14	
Stillwater	88	44	71.2	5.61	
Waukomis	94	43	70.4	3.82	
Winnview	89	41	69.8	5.25	
Woodward	91	47	73.6	2.91	
Oregon.					
Albany b	......	......	......	2.66	
Arlington	82	36	57.4	0.58	
Ashland b	82	29	51.0	1.30	0.9
Aurora (near)	71	31	51.1	3.55	
Bandon	64	38	52.3	4.58	
Bay City	62	31	49.0	9.32	
Beulah	81	19	47.9	1.15	
Bullrun	66	38	48.3	8.38	
Burns	76	22	43.0	0.16	
Burns (near)	78	26	46.9	1.17	T.
Cascade Locks	72	40	53.0	4.65	
Coquille River	......	......	......	4.53	
Corvallis	72	35	52.6	2.26	
Dayville	79	30	51.2	1.30	T.
Ella	......	......	......	0.46	
Eugene [4]	72	33	50.7	2.80	
Fairview	70	33	48.9	3.97	
Falls City	74	31	50.6	3.12	
Forestgrove	72	30	50.1	2.79	
Gardiner	68	36	53.9	5.70	
Glenora	73	32	49.6	6.94	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Oregon—Cont'd.	°	°	°	*Ins.*	*Ins.*
Government Camp	59	26	38.6	8.47	46.0
Grants Pass	85	29	53.2	3.04	
Happy Valley	77	21	44.4	2.15	1.5
Heppner	76	29	50.6	2.17	
Hood River (near)	74	32	50.0	2.16	
Jacksonville	80	30	51.6	2.81	
Joseph	71	20	43.6	1.62	4.5
Kerby	81	27	52.8	1.80	
Klamath Falls	87	22	48.8	0.10	
Lagrande	80	32	51.3	......	
Lakeview	77	18	45.6	1.10	1.5
Langlois	68	35	53.5	6.91	
Lonerock	73	21	48.8	1.32	T.
Lorella	72	19	42.5	T.	
McMinnville	70	32	50.6	2.89	
Monmouth b	68	32	51.0	2.28	
Monroe	70	32	51.4	2.15	
Mount Angel	77	36	52.2	3.83	
Nehalem	......	......	......	8.07	
Newberg	73	31	51.5	3.21	
Newbridge	90	22	51.7	0.88	
Newport	61	37	49.8	4.64	
Pendleton	83	32	55.6	1.66	
Placer	......	......	......	3.53	
Prineville	78	23	47.7	0.74	
Riverside	81	19	49.8	1.38	
Salem b	74	34	53.0	3.90	
Silver Lake	78	18	43.9	0.49	T.
Sparta	71	24	44.5	2.70	2.0
Stafford	69	36	50.3	3.89	
The Dalles	82	34	55.6	0.45	
Tillamook Rock	......	......	......	4.32	
Toledo	69	34	50.7	5.45	
Umatilla	......	......	......	0.66	
Vale	83	20	52.6	1.39	
Vernonia	73	32	49.0	3.65	
Weston	78	30	51.1	3.08	
Williams	83	29	51.8	1.70	
Pennsylvania.					
Altoona	93	37	60.8	5.62	
Aqueduct	96	42	65.8	3.65	
Athens	90	31	59.0	3.15	
Beaver Dam	......	......	......	4.64	
Bethlehem	......	......	......	1.76	
Brookville	......	......	......	5.39	
Browers Lock	......	......	......	2.14	
Butler	85	34	60.2	4.39	
Carlisle	87	40d	63.4	6.36	
Cassandra	85	35	59.5	4.78	
Cedarrun	......	......	......	2.27	
Centerhall	92	38	60.2	5.66	
Chambersburg	88	......	......	5.99	
Coatesville	92	37	62.6	2.77	
Confluence	91	35	61.4	5.71	
Coopersburg	86	41	60.6	3.14	
Davis Island Dam	......	......	......	3.64	
Derry Station	100	37	65.4	3.57	
Driftwood	......	......	......	4.85	
Duncannon	......	......	......	4.93	
Dushore	88	28	57.2	2.20	
East Bloomsburg	......	......	......	3.32	
East Mauch Chunk	90	40	61.6	2.66	
Easton	86	41	62.2	2.51	
Ellwood Junction	......	......	......	4.81	
Emporium	89	35	59.6	3.92	
Everett	88	30	61.4	4.39	
Farrandsville	......	......	......	3.55	
Forks of Neshaminy *[1]	86	50	62.0	2.35	
Franklin	86	35	60.4	5.28	
Frederick	......	......	......	3.30	
Freeport	......	......	......	4.84	
Girardville	......	......	......	3.53	
Grampian	84	38	60.2	5.34	
Greensboro	88	38	64.4	5.16	
Hamburg	90	40	62.8	4.83	
Hawley	92	33	60.5	3.42	
Hawthorn	86	35	60.8	6.17	
Hews Island Dam	......	......	......	3.06	
Huntingdon a	95	37	62.1	4.48	
Huntingdon b	......	......	......	3.83	
Irwin	......	......	......	3.13	
Johnstown	92	39	63.5	6.20	
Karthaus	......	......	......	3.04	
Keating	......	......	......	3.69	
Kennett Square	90	37	62.0	2.74	
Lansdale	......	......	......	1.15	
Lawrenceville	80c	30c	56.4c	2.81	
Lebanon	88	40	61.6	4.53	
Leroy	89	38	58.7	2.07	
Lewisburg	89	34	60.8	4.32	
Lock Haven a	96	39	63.6	3.67	
Lock Haven b	......	......	......	3.30	
Lock No. 4	......	......	......	4.38	
Lycippus	......	38	......	5.01	
Mifflin	......	......	......	5.00	
Nisbet	......	......	......	3.00	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Pennsylvania—Cont'd.	°	°	°	Ins.	Ins.
Oil City	.....	.....	......	5.14	
Ottsville	.....	.....	......	2.21	
Parker	.....	.....	......	4.49	
Philadelphia	90	45	64.0	2.30	
Point Pleasant	.....	.....	......	1.55	
Quakertown	88	37	60.5	3.04	
Reading[2]	.....	.....	61.6	2.74	
Renovo *a*	.....	.....	......	3.47	
Renovo *b*	90	38	62.0	3.43	
Ridgway	.....	.....	......	3.86	
Saegerstown	86	32	59.4	5.95	
St. Marys	.....	33	......	4.77	
Salem Corners	86	35	58.6	2.76	
Scranton	90	37	61.0	2.73	
Selinsgrove *a*	90	37	62.0	4.45	
Shawmont	.....	.....	......	2.18	
Shinglehouse	92	28	59.7	......	
Sinnamahoning	.....	.....	......	2.37	
Smethport	85	30	57.0	5.33	
Smiths Corners	.....	.....	......	2.11	
Somerset	86	30	59.0	4.96	
South Eaton	87	37	59.8	2.24	
State College	87	40	60.7	4.77	
Sunbury	.....	.....	......	3.55	
Swarthmore	88	42	63.0	3.30	
Swiftwater	82	35	56.8	1.48	
Towanda	88	32	59.2	2.10	
Trout Run	.....	.....	......	3.91	
Uniontown	89	36	62.6	5.09	
Warren	81	33	56.6	6.40	
Wellsboro	90	30	58.2	2.15	
West Chester	88	42	62.1	2.63	
West Newton	.....	.....	......	4.81	
Westtown	87	37	60.8	......	
White Haven	98	24	57.1	......	
Wilkesbarre	94	39	63.0	2.07	
Williamsport	86	40	62.0	2.36	
York	89	37	62.3	5.71	
Rhode Island.					
Bristol	74	39	55.8	2.38	
Kingston	82	35	55.2	1.88	
Lonsdale	.....	.....	......	1.72	
Pawtucket	84	43	60.6	2.03	
Providence *a*	88	41	60.5	2.60	
Providence *c*	84	38	57.8	2.59	
South Carolina.					
Allendale	98	54	73.8	0.78	
Anderson	.....	.....	......	2.05	
Batesburg	98	50	75.4	1.01	
Beaufort	97	57	76.8	1.47	
Blackville	99	51	75.8	1.70	
Calhoun Falls	.....	.....	......	2.39	
Camden	.....	.....	......	0.53	
Central	96	50	73.4	1.15	
Cheraw *a*	97	49	73.4	1.30	
Cheraw *b*	.....	.....	......	1.76	
Clemson College	94	48	69.2	1.26	
Conway	.....	.....	......	2.85	
Darlington	.....	.....	......	0.61	
Edisto	.....	.....	......	1.40	
Effingham	.....	.....	......	1.50	
Florence	97	48	73.0	0.75	
Gaffney	.....	.....	......	1.29	
Georgetown	97	52	73.8	3.50	
Greenville	90	47	69.0	0.80	
Greenwood	97	49	74.8	1.84	
Holland	94	45	70.6	3.38	
Kingstree *a*	97	51	74.4	0.97	
Kingstree *b*	.....	.....	......	0.95	
Little Mountain	99	49	75.2	1.87	
Longshore	98	48	74.0	1.48	
Pinopolis *[1]	93	55	72.5	3.72	
St. Georges	97	54	74.7	0.68	
St. Matthews	99	52	74.8	1.42	
St. Stephens	.....	.....	......	0.77	
Santuck	95	46	72.4	2.51	
Shaws Fork	93	46	71.2	0.97	
Smiths Mills	.....	.....	......	2.30	
Society Hill	94	49	75.6	1.00	
Spartanburg	96	47	72.7	1.10	
Statesburg	98	51	75.3	1.15	
Summerville	95	52	73.3	2.22	
Temperance	100	48	73.2	1.68	
Trenton	95	58	75.4	1.26	
Trial	95	48	71.6	2.52	
Winnsboro	92	48	71.2	1.62	
Yemassee	99	52	76.0	2.78	
Yorkville	97	48	73.6	1.97	
South Dakota.					
Aberdeen	88	24	55.5	8.70	
Alexandria	90	26	57.4	3.87	
Armour	89	27	57.0	4.63	
Ashcroft	84	23	50.7	3.04	1.0
Bowdle	89	23	51.4	4.81	
Brookings	85	25	55.2	3.38	
Canton	85	.....	......	8.48	
South Dakota—Cont'd.	°	°	°	Ins.	Ins.
Centerville	.....	.....	......	6.41	
Chamberlain	90	32	59.2	4.61	
Chandler	90	30	57.2	3.25	
Clark	.....	.....	......	3.19	0.5
Desmet	85	26	54.9	3.80	
Doland	90	22	56.3	3.40	
Elkpoint	85	33	60.6	7.60	
Farmingdale	.....	.....	......	4.03	......
Flandreau	88	28	57.4	4.64	T.
Forestburg	90	26	55.8	4.35	
Forest City	92	30	56.7	2.10	
Fort Meade	.....	21	......	6.75	
Gann Valley	92[h]	24[h]	58.6[h]	4.15	
Goudyville	88	23	53.5	4.80	T.
Highmore	91	28	53.8	3.75	0.5
Hitchcock	.....	.....	......	3.49	
Hotch City	.....	29	......	3.56	
Hot Springs	85	22	51.3	4.24	
Howard	88	32	58.2	3.28	
Interior	80	30	51.4	5.00	
Ipswich	90	22	54.0	4.51	
Kimball	91	30	57.2	2.46	
Leola	86	20	51.0	5.13	
Leslie	92	30	55.0	2.84	......
Mellette	90	22	57.1	4.56	
Menno	91	28	58.3	4.94	
Millbank	87	26	55.4	3.97	
Mitchell	90	25	56.4	3.47	
Montrose	89	27	56.3	4.41	.....
Oelrichs	84	23	55.0	6.00	
Parker	87	26	58.0	5.38	
Plankinton	90[c]	23[c]	58.3[c]	2.82	
Redfield	89	25	54.7	3.59	
Rochford	77	20	45.4	7.12	
St. Lawrence	89	25	56.3	3.57	T.
Silver City	.....	.....	......	7.74	
Sioux Falls	87	27	57.2	5.63	
Spearfish	82	29	51.2	3.85	
Tyndall	88	31	57.2	4.73	
Watertown	85	26	53.4	3.79	
Waubay	87	24	54.4	3.61	
Wentworth	86	27	56.3	3.84	
Wessington Springs	88	27	53.1	3.13	
Whiteswan	89	34	50.1	3.84	
Wolsey	.....	.....	......	3.16	
Tennessee.					
Andersonville	89	45	69.4	3.85	
Arlington	95	54	73.5	5.48	
Ashwood	89	51	72.6	2.41	
Benton (near)	96	50	72.4	3.43	
Bluff City	.....	.....	......	5.53	
Bolivar	91	54	72.6	2.23	
Bristol	87	43	66.1	3.80	
Brownsville	94	54	73.7	2.58	
Byrdstown	89	49	70.0	6.35	
Carthage	90	52	71.6	4.19	
Clarksville	88	52	70.2	5.83	
Clinton	.....	.....	......	1.94	
Covington	94	59	75.6	3.04	
Decatur	91	49	71.3	4.41	
Dover[f]	98	47	73.0	4.56	
Dyersburg	91	55	72.9	4.48	
Elizabethton	92	44	69.2	4.86	
Elk Valley	.....	45	......	4.44	
Erasmus	89	40	66.1	6.72	
Florence	90	59	73.4	5.47	
Franklin	88	52	71.4	2.66	
Grace *[1]	94	50	71.7	5.80	
Greeneville	89	44	67.3	4.30	
Harriman	91	48	70.2	4.21	
Hohenwald	89	49	70.4	2.13	
Jackson	90	55	72.2	3.85	
Johnsonville	91	48	71.4	4.19	
Jonesboro *[1]	84	57	67.2	3.10	
Kingston	.....	.....	......	4.20	
Lafayette *[5]	92	51	70.2	4.07	
Lewisburg	.....	.....	......	2.50	
Liberty	92	51	72.3	3.31	
Lynnville	92	54	73.0	1.42	
McKenzie	89[f]	54[f]	73.2[f]	3.57	
Madison	92	48	71.8	3.27	
Maryville *[5]	91	49	71.0	5.08	
Milan	93	55	73.4	5.91	
Nashville (near)	98	53	73.8	1.87	
Newport	89	46	69.2	3.38	
Nunnelly	90	47	70.8	4.02	
Oak Hill	90	48	68.3	4.99	
Palmetto	91	49	72.6	2.52	
Peryear *[5]	92	55	73.2	4.40	
Pope	93	47	71.8	2.43	
Rogersville	87	47	67.0	4.96	
Rugby	86	43	67.2	4.51	
Savannah	92	53	73.6	1.17	
Sewanee	88	52	69.8	3.08	
Silverlake	83	40	62.8	4.22	
Springdale	94	44	69.4	5.43	
Tennessee—Cont'd.	°	°	°	Ins.	Ins.
Springfield	90	49	71.0	3.25	
Tazewell	.....	.....	......	4.98	
Tellico Plains	92	50	71.2	3.32	
Tracy City	87	49	68.4	2.27	
Trenton	92	54	75.0	4.47	
Tullahoma	88	49	70.2	2.65	
Union City	89	53	71.2	2.80	
Waynesboro	89	48	70.8	1.05	
Wildersville	88	54	72.2	5.37	
Yukon	91	55	73.8	1.12	
Texas.					
Albany *[1]	88	56	74.2	3.57	
Alvin	.....	.....	......	0.16	
Anna	91	53	75.0	2.06	
Anson	.....	.....	......	3.00	
Arthur	.....	.....	......	6.55	
Austin *a*	94	58	77.8	3.70	
Austin *b* *[5]	91	58	74.4	......	
Ballinger	93	54	74.1	5.21	
Beaumont	102	51	77.0	2.00	
Beeville	94	61	78.5	2.50	
Blanco	96	60	74.8	3.10	
Boerne *[1]	91	64	76.2	3.10	
Brazoria	89	65	77.2	0.25	
Brenham	94	65	78.2	1.28	
Brighton	88	68	79.2	2.58	
Brownwood	95	.....	......	4.72	
Burnet *[1]	90	60	75.1	2.85	
Camp Eagle Pass	103	61	83.2	3.00	
Childress	.....	.....	......	3.76	
Coleman	92	56	73.8	5.14	
College Station[2]	.....	60	76.2	3.14	
Colorado	.....	.....	......	3.20	
Columbia	90	64	76.8	0.10	
Conroe	96	61	78.0	0.26	
Corsicana	97	61	79.2	2.31	
Cuero	97	64	79.3	1.66	
Dallas	94	57	76.0	3.61	
Danevang	98	61	79.3	0.82	
Desdimonia	98[e]	56[b]	78.8[c]	6.20	
Dublin	91	54	74.0	4.47	
Duval	98	61	79.2	2.95	
Emory	92	59	76.4	2.55	
Estelle	95	57	76.6	4.04	
Fort Brown	93	69	82.0	T.	
Fort Ringgold	101	65	84.8	0.12	
Fort Stockton	.....	.....	......	0.00	
Fredericksburg *[1]	91[d]	60[d]	75.5[d]	3.40	
Fruitland	93	51	73.8	3.56	
Gainesville	91	53	74.6	3.31	
Georgetown *[1]	92	62	76.8[e]	2.81	
Golindo	.....	.....	......	5.30	
Grapevine	94[d]	55[d]	77.4[d]	2.03	
Hale Center	93	41	70.6	2.53	
Hallettsville	94	65	79.6	1.77	
Hearne	94	68	80.5	1.45	
Henrietta	94	40	74.3	2.36	
Hewitt[f]	.....	.....	......	5.60	
Hondo	.....	.....	......	1.98	
Honeygrove	.....	.....	5.47	......	
Houston	91	67	77.8	3.49	
Hulen	93	63	78.5	0.09	
Huntsville	94	66	79.0	1.20	
Jacksonville	92	62	77.0	2.95	
Jasper	92	60	77.9	0.70	
Junction	.....	.....	......	1.00	
Kent	.....	.....	......	0.04	
Kerrville	92	55	74.6	3.17	
Lampasas	93	56	77.0	4.24	
La Parra	.....	.....	......	2.00	
Laureles Ranch	.....	.....	......	1.90	
Llano *[5]	92	63	77.8	4.65	
Longview	97	60	78.8	6.87	
Luling	94	63	79.1	2.36	
Mann	93[f]	58[f]	74.3[f]	3.32	
Marathon	98	42	73.0	T.	
Monahans	.....	.....	......	1.26	
Mount Blanco	97	39	70.9	1.22	
New Braunfels	94	62	79.0	2.35	
Panter	.....	.....	......	2.89	
Paris *a*	93	59	74.6	2.28	
Point Isabel *[1]	88[j]	76[j]	80.7[j]	0.00	
Rhineland	98	50	77.4	1.95	
Rock Island	.....	.....	......	1.50	
Rockport *[1]	85	65	74.2	......	
Rocksprings	.....	.....	......	T.	
Runge	94	63	79.8	3.27	
Sabine Pass	102	67	83.3	0.00	
San Antonio	95	64	79.6	2.34	
Sanderson	91[f]	68	71.8[f]	0.80	
San Marcos	90	62	75.6	3.61	
Sherman	91	56	75.4	1.72	
Sugarland	104	69	84.8	1.15	
Sulphur Springs	90[e]	60[e]	75.2[e]	3.43	
Temple *a*	92	58	76.8	4.19	
Temple *b*	94	58	76.7	3.56	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Texas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Tulia	94	34	65.4	3.17	
Tyler	95	52	74.4	4.73	
Victoria	......	......	......	3.00	
Waco	94	63	79.4	4.90	
Waxahachie	93	56	76.9	3.50	
Weatherford	96	55	76.5	5.25	
Wichita Falls	......	......	......	2.86	
Utah.					
Alpine	......	......	......	1.15	
Bluecreek[1]	82	30	54.2	1.27	T.
Brigham	......	......	......	1.20	......
Castledale	80	24	52.6	0.00	
Cisco	88	27	57.8	0.20	2.0
Corinne	83	27	53.8	0.86	5.0
Croydon	78	21	46.7	1.80	
Fillmore	88	23	53.7	0.85	
Fort Duchesne	84	28	53.2	T.	
Frisco	82	19	52.0	0.08	......
Giles	94	37	60.1	0.03	
Grover	78	15	49.2	0.02	0.2
Heber	80	24	49.5	1.14	
Huntsville	......	......	......	0.65	
Kelton *[1]	82	33	56.1	0.20	2.0
Levan	81	20	50.6	1.75	T.
Loa	78	15	48.0	0.17	T.
Logan	76	25	51.1	1.87	......
Manti	84	25	53.2	......	......
Marysvale	......	......	......	1.50	10.0
Millville	......	......	......	1.50	
Minersville	85	23	52.6	0.65	
Moab	95	29	63.6	0.39	1.5
Mount Pleasant	90	19	52.4	1.02	
Ogden *a*	......	......	......	0.89	
Pahreah	96	28	57.8	T.	
Parowan	84	20	52.4	1.19	10.5
Pinto	......	15	......	0.58	
Promontory *[1]	80	34	55.6	0.57	3.0
Provo	86	28	55.2	1.37	
Richfield	76	......	......	T.	
St. George	94	20	60.0	0.05	
Scipio	82	18	50.1	0.70	T.
Snowville	73	22	47.2	0.75	4.0
Soldier Summit	73	22	49.6	0.65	6.0
Thistle	......	......	......	0.88	3.0
Tooele	82	22	52.0	2.28	......
Tropic	84	17	47.9	0.14	
Vernal	80	28	54.6	0.09	
Woodruff	72	20	43.8	1.14	1.0
Vermont.					
Bennington	87	31	57.8	2.11	
Brattleboro	90	31	59.2	1.24	
Burlington	80	38	58.1	2.01	
Chelsea	79	31	52.8	1.82	
Cornwall	82	36	57.0	1.70	
Derby	80	27	53.5	1.42	
Enosburg Falls	79	28	54.2	2.11	
Hartland	86	26	53.7	1.13	
Jacksonville	84	28	54.8	0.84	
Norwich	86	27	54.2	1.56	
St. Johnsbury	80	28	53.6	1.22	T.
Vernon *[6]	84	43	58.8	0.89	
Wells	82	30	56.0	1.84	
Woodstock	82	26	51.8	0.92	
Virginia.					
Alexandria	94	44	66.0	2.63	
Ashland	92	41	67.3	3.14	
Barbourville	89	44	66.2	2.50	
Bedford City	93	40	68.0	......	
Bigstone Gap	90	42	66.8	6.10	
Birdsnest *[1]	86	51	65.0	3.15	
Blacksburg	88	35	62.8	3.96	
Buckingham	92	39	65.6	4.36	
Burkes Garden	82	39	60.8	6.29	
Callaville	88	45	66.3	5.62	
Charlottesville	90	48	65.9	3.13	
Christiansburg	......	......	......	3.39	
Clarksville	......	......	......	2.08	
Clifton Forge	86	48	65.2	......	
Columbia	......	39	......	1.46	
Dale Enterprise	93	34	63.2	3.75	......
Danville	......	......	......	3.39	
Doswell	94	35	66.7	2.45	
Farmville	95	41	68.9	2.84	
Fontella	92	44	68.0	3.89	
Fredericksburg	91	41	66.0	5.18	
Grahams Forge	86[c]	36[c]	63.1[c]	3.13	
Hampton	88	51	67.2	2.34	
Hot Springs	83	39	60.5	4.43	
Leesburg	......	......	......	1.30	
Lexington	87	41	64.6	5.00	
Manassas	90	44	65.2	2.06	
Marion	86[c]	30[c]	64.8[c]	6.75	
Miller School	90[c]	41	69.2[c]	2.12	
Newport News	94	50	69.2	2.32	
Petersburg	92	42	68.2	4.16	
Quantico	89	34	62.4	......	

Stations	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Virginia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Radford	......	......	......	3.45	
Richmond (near)	94	45	67.8	2.16	
Rockymount	90	40	68.4	2.81	
Salem	90	46	67.8	2.35	
Speers Ferry	......	......	......	5.12	
Spottsville	92	38	67.0	2.19	
Stanardsville	90	39	65.3	3.55	
Staunton	92	40	65.0	3.64	
Stephens City	92	40	64.4	6.65	
Sunbeam	93	41	66.1	3.93	
Tobaccoville[4]	93	41	66.4	2.63	
Warrenton	86	49	64.2	3.72	
Warsaw	89	38	65.4	3.87	
Westbrook	94	41	67.2	......	
Westpoint	......	......	......	2.54	
Woodstock	90	41	63.8	5.71	
Wytheville	87	38	64.2	3.43	
Washington.					
Aberdeen *	69	34	50.3	4.40	
Anacortes	......	......	......	0.76	
Ashford	......	......	......	6.28	2.0
Blaine	72	21	46.8	3.51	
Bremerton	73	34	51.0	2.19	
Bridgeport	86	26	55.4	0.10	
Brinnon	70	34	50.6	3.53	
Cedar Lake	......	......	......	9.83	
Cedonia	74	23	45.3	2.57	2.5
Centerville	78	23	51.6	0.97	
Chehalis	73	32	50.8	3.73	
Cheney	......	......	......	0.10	
Clearwater	......	31	......	10.87	
Cle Elum	72	27	46.6	0.28	T.
Colfax	78	28	52.4	1.43	0.5
Connell	......	......	......	0.05	
Coupeville	68	32	49.8	1.87	
Crescent	83	28	50.4	1.71	0.6
Dayton	78	29	51.9	1.28	
Ellensburg	77	30	52.0	0.39	
Ellensburg (near)	82	32	53.7	0.27	
Fort Simcoe	80	30	53.6	0.64	T.
Grandmound	73	35	51.0	3.42	
Hooper	81	30	53.9	0.95	
Kennewick	86	35	59.2	0.30	
Lacenter	70	36	50.6	5.70	
Lakeside	81	35	57.2	0.54	
Lind	88	25	55.9	0.57	
Loomis	83	24	55.7	1.88	
Mayfield	73	34	52.0	4.73	
Montecristo	61	28	42.0	8.03	27.0
Moxee Valley	81	24	53.9	0.46	
New Whatcom	63	30	50.4	3 15	
Northbend	69	32	51.1	5 80	
Northport	85[g]	30[g]	54.5[g]	2.36	T.
Olga	68	35	49.6	2.50	
Olympia	74	32	50.8	3.39	
Orcas Island	69	38	51.9	1.89	
Pinehill	75	32	52.2	0.64	
Pomeroy	76	32	55.3	0.87	T.
Port Townsend	66	38	50.0	1.73	
Pullman	73	30	48.6	1.94	
Ritzville	......	......	......	0.71	0.5
Rosalia	76	28	48.4	1.39	
Sedro	73	36	52.2	6.58	
Silvana	69	30	49.4	4.74	
Snohomish	70	35	51.5	5.39	
Snoqualmie	73	35	52.2	6.65	
Southbend	66	34	48.6	6.29	
Sprague	......	......	......	0.06	
Sunnyside	83	24	55.6	0.62	
Tunnel	70	30	50.0	7.00	60.0
Union City	71	32	51.0	3.57	
Usk	81	21	51.6	2.60	
Vancouver	68	35	51.5	4.00	
Vashon	65	35	51.0	2.07	
Waterville	78	16	48.8	0.72	
Wenatchee (near)	78	28	52.0	0.37	
West Virginia.					
Beckley	86	36	61.2	3.53	
Beverly	90	38	63.0	5.53	
Bluefield	85	39	63.9	6.02	
Buckhannon *a*	......	......	......	3.99	
Buckhannon *b*	89	40	63.1	......	
Burlington	88	38	63.2	6.94	
Cairo	90	39	64.2	5.85	
Charleston	......	......	......	3.45	
Dayton	89	37	62.9	6.00	
Eastbank	91	47	68.6	4.60	
Elkhorn	89	41	64.9	4.29	
Fairmont	......	......	......	5.57	
Glenville	87	42	64.6	3.27	
Grafton	90	40	64.0	4.71	
Green Sulphur	89	36	64.1	5.82	
Harpers Ferry	......	......	......	3.96	
Hinton *a*	......	......	......	5.32	
Hinton *b*	91	44	67.2	......	
Huntington	94	42	67.0	4.44	

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
West Virginia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Kingwood	87	38	61.6	6.83	
Marlinton	85	37	61.0	7.68	
Martinsburg	92	42	63.3	5.15	
Morgantown	92	40	64.4	4.72	
New Cumberland	92	37	65.0	4.14	
New Martinsville	89	41	65.3	3.17	
Nuttallburg	89	40	64.0	5.95	
Oceana	91	42	66.6	5.10	
Oldfields	91	38	62.8	4.95	
Parsons	85	38	61.9	6.93	
Philippi	90	40	64.4	6.68	
Point Pleasant	96	42	68.2	3.37	
Powellton	88	43	64.6	6.80	
Romney	88	42	64.2	7.32	
Rowlesburg	......	......	......	5.72	
Terraalta	......	......	......	6.82	
Upper Tract	93	35	64.1	3.75	
Weston *a*	......	......	......	5.70	
Weston *b*	90	41	66.3	......	
Wheeling *a*	......	......	......	3.77	
Wheeling *b*	90	45	68.0	3.90	
Wisconsin.					
Amherst	82	31	55.6	3.65	
Barron	74	30	53.2	3.15	
Bayfield	82	31	48.4	2.70	
Beloit	79	40	60.2	6.15	
Brodhead	81	38	60.1	6.16	
Chilton	79	34	58.0	3.40	
Citypoint	83	35	58.6	4.36	
Delavan	85	38	59.8	5.16	
Dodgeville	82	36	58.0	4.64	
Easton	84	30	57.2	4.99	
Eau Claire	82	34	57.8	8.47	
Florence	81	25	52.0	4.41	
Fond du Lac	83	30	57.8	2.21	
Grand River Locks	......	......	......	3.94	
Grantsburg	81	32	53.3	5.97	
Gratiot	82	36	58.8	7.45	
Hartford	81	38	58.2	5.81	
Hartland	79	37	57.5	4.11	
Harvey	80	37	58.2	6.96	
Hayward	82	30	56.5	4.84	
Heafford Junction	82	27	53.2	4.66	
Hillsboro	83	......	......	3.62	
Knapp	83	30	55.5	5.87	
Koepenick *[1]	82	40	59.2	3.30	
Lancaster	83	36	58.8	5.25	
Lincoln	80	34	55.5	1.08	
Madison	77	39	58.2	4.92	
Manitowoc	80	36	52.8	3.07	
Meadow Valley	84	34	57.2	3.20	
Medford	85	26	54.6	6.40	
Menasha	......	......	......	2.26	
Neillsville	80	32	56.2	5.14	
New Holstein	79	30	56.4	3.95	
New London	81	30	55.4	3.15	
Oconto	83	33	55.1	2.76	
Osceola	81	29	55.1	3.41	
Oshkosh	80	41	60.3	2.77	
Pepin	82	35	59.4	4.42	
Pine River	83[c]	33[c]	56.2[c]	1.95	
Portage	84	38	58.8	4.02	
Port Washington	80	34	53.7	3.48	
Prairie du Chien	85	39	61.3	2.93	
Prentice *[1]	79	32	51.7	7.17	
Racine	81	38	56.6	4.89	
Sharon	88[g]	36[g]	58.8[g]	5.54	
Shawano	82	30	54.5	2.24	
Spooner	83	29	56.0	3.89	
Stevens Point	83	31	56.4	2.28	
Sturgeon Bay Canal *[10]	70	36	49.8	......	
Two Rivers *[10]	78	40	52.9	......	
Valley Junction	83	34	56.8	4.82	
Viroqua	83	35	57.7	4.03	
Watertown	80	36	58.2	4.82	
Waukesha	79	38	57.4	3.92	
Waupaca	84	33	57.1	2.66	
Wausau	78	32	55.4	4.43	
West Bend	80	35	58.3	5.39	
Westfield	83	35	57.0	4.77	
Whitehall	83	33	58.4	4.34	
Wyoming.					
Alcova	80	13	48.5	2.09	0.2
Basin	87	25	54.6	0.57	......
Big Piney	70	16	45.5	0.50	5.0
Bitter Creek	85	18	50.4	0.10	1.0
Buffalo	82	22	50.1	4.05	6.0
Burns	72	10	40.4	0.84	......
Carbon	85	18	49.4	0.59	......
Centennial	72	15	44.1	0.85	7.6
Cody	76	18	49.2	1.52	0.2
Douglas	81	20	50.8	4.08	T.
Embar	79	23	51.4	1.40	
Evanston	73	18	42.7	2.09	13.0
Fort Laramie	86	23	53.1	4.29	
Fort Washakie	76	16	47.9	2.01	3.7

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Wyoming—Cont'd.	°	°	°	*Ins.*	*Ins.*
Fort Yellowstone	71	15	42.4	2.52	6.0
Four Bear	71	10	41.8	2.21	18.5
Hecla	77	20	49.0	0.68	
Laramie	72	18	44.8	0.37	0.4
Lovell	86	22	52.6	0.96	0.8
Lusk	83	20	50.1	4.22	
Rawlins	72	30	48.2	1.20	3.6
Rocksprings	74	22	48.2	0.52	0.2
Sheridan	79	22	48.9	4.74	1.0
Thayne	71	11	45.0	2.40	7.3
Thermopolis	81	22	51.6	......	......
Wamsutter	......	......	......	0.05	0.5
Wheatland	81	23	50.0	2.55	T.
Mexico.					
Ciudad P. Diaz	96	68	83.0	2.93	
Coatzacoalcos [3]	......	......	81.9	......	
Leon de Aldamas	93	52	73.6	1.15	
Puebla	87	50	68.0	2.26	
Tampico [3]	......	......	81.2	......	
Topolobampo *[1]	96	64	77.4	0.00	
Vera Cruz [3]	......	......	81.4	......	
New Brunswick.					
St. John	77	34	48.5	4.14	
Porto Rico.					
Adjuntas	93	57	73.2	6.79	
Aguadilla	87	72	79.8	6.48	
Arecibo	87	58	72.7	11.35	
Bayamon	95	60	78.7	5.53	
Caguas	......	62	......	1.70	
Canovanas	87	71	79.2	2.27	
Cayey	92	62	76.0	2.20	
Coamo	94	61	77.5	3.68	
Isabela	87	65	77.6	2.47	
Porto Rico—Cont'd	°	°	°	*Ins.*	*Ins.*
Loiza	89	71	79.9	......	
Luquillo	89	68	78.0	6.79	
Manati	94	63	74.4	7.03	
Maunabo	91	63	79.7	......	
Morovis	......	62	......	3.95	
Puerta de Tierra	92	70	80.3	2.81	
San German	......	......	......	1.62	
Utuado	94	59	76.0	3.87	
Vieques	91	68	78.6	3.26	

Late reports for April, 1899.

Stations.	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Alaska.					
Coal Harbor	50	25	35.8	1.82	6.0
Killisnoo	47	30	38.6	1.60	0.5
Arizona.					
Dragoon	......	......	......	0.21	
Lochiel *[1]	82	40	58.9	0.54	
Walnut Grove	......	......	......	0.00	
California.					
Chino	......	......	......	0.05	
San Miguel Island	78	40	54.6	1.33	
Florida.					
Haywood	......	......	......	2.30	
New Mexico.					
Shattucks Ranch	87	25	55.4	2.18	1.0
Texas.					
Junction	......	......	......	1.75	

EXPLANATION OF SIGNS.

* Extremes of temperature from observed readings of dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m + 2 p. m. + 9 p. m. + 9 p. m. ÷ 4.
[2] Mean of 8 a. m. + 8 p. m. ÷ 2.
[3] Mean of 7 a. m. + 7 p. m. ÷ 2.
[4] Mean of 6 a. m. + 6 p. m. ÷ 2.
[5] Mean of 7 a. m. + 2 p. m. ÷ 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.
[7] Mean from hourly readings of thermograph.
[8] Mean of 7 a. m. + 2 p. m. + 9 p. m. ÷ 3.
[9] Mean of sunrise and noon.
[10] Mean of sunrise, noon, sunset, and midnight.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance, "n" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks, of whatever duration, in the precipitation record receive appropriate notice.

CORRECTIONS.

NOTE.—The following changes have been made in names of stations:

New York, Niagara Falls changed to Mayle.

TABLE III.—*Mean temperature for each hour of seventy-fifth meridian time, May, 1899.*

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midn't.	Mean.
Bismarck, N. Dak....	48.4	47.5	46.6	45.3	44.7	44.1	44.0	45.2	46.6	49.2	51.4	53.4	55.4	57.0	58.5	59.1	59.6	59.9	59.4	58.0	55.7	53.4	51.4	49.7	51.8
Boston, Mass	52.6	52.0	51.2	50.7	50.2	51.0	53.0	56.1	58.5	60.1	61.5	61.9	62.5	63.2	62.9	62.3	61.4	60.9	59.0	57.7	56.5	55.5	54.5	53.7	57.0
Buffalo, N. Y.........	54.3	53.3	52.6	52.3	51.9	52.0	53.3	55.1	56.2	56.8	57.6	58.5	59.5	59.5	59.8	59.5	58.6	58.3	57.6	57.1	56.4	55.5	54.8	54.4	56.0
Chicago, Ill..........	56.7	56.2	55.9	55.2	54.9	54.2	54.4	56.2	57.3	58.7	59.6	60.3	61.5	62.1	62.9	63.8	63.2	63.0	61.5	59.5	58.7	58.5	58.4	57.4	58.8
Cincinnati, Ohio....	64.0	62.8	62.1	61.1	60.5	60.0	60.5	62.5	64.9	66.9	68.6	70.4	71.3	72.3	72.6	72.7	73.0	72.6	71.5	70.2	68.9	67.4	66.0	64.8	67.0
Cleveland, Ohio	57.7	56.8	56.0	55.8	55.7	55.4	56.0	57.5	60.0	61.0	60.7	61.7	61.9	62.1	63.1	62.5	63.2	63.1	62.8	62.4	61.3	60.6	59.2	58.1	59.8
Detroit, Mich........	56.0	55.5	54.9	54.4	53.5	53.3	53.9	56.1	57.6	59.5	61.0	62.5	64.1	64.7	65.3	66.0	66.1	65.6	64.4	62.4	60.4	58.8	57.6	56.7	59.6
Dodge, Kans..........	60.0	58.8	57.5	56.5	55.7	55.1	54.1	55.8	59.7	63.5	67.7	71.0	74.0	76.0	77.1	78.7	79.2	78.5	76.6	73.6	69.2	66.3	63.5	62.2	66.3
Eastport, Me..........	43.4	42.8	42.4	42.1	41.9	42.8	44.4	46.3	48.2	49.4	50.8	52.0	52.6	52.8	52.9	53.1	51.4	50.4	48.8	47.6	46.7	46.0	45.3	44.6	47.4
Galveston, Tex........	76.4	76.3	76.2	76.0	75.9	75.7	75.8	76.1	77.2	79.9	78.8	79.5	80.0	80.4	80.4	80.0	79.5	78.9	78.2	77.5	77.1	77.0	76.9	76.7	77.7
Havre, Mont..........	44.4	43.5	42.3	41.3	40.4	39.9	39.3	39.5	40.1	42.1	44.3	46.4	49.0	50.5	51.9	52.7	53.6	53.9	53.4	52.7	51.5	50.2	48.1	46.4	46.5
Independence, Cal..	58.8	57.2	55.5	54.3	53.4	52.7	54.9	50.4	51.1	53.6	57.3	60.5	63.7	65.7	68.1	69.1	69.5	69.8	69.8	69.0	66.8	64.3	61.9	60.4	60.8
Kansas City, Mo......	64.9	64.2	63.0	61.5	61.3	60.3	60.0	60.8	62.4	65.3	67.7	70.0	71.1	73.0	73.9	74.8	74.9	74.7	73.2	71.7	69.6	68.0	67.0	65.8	67.5
Key West, Fla..........	76.9	76.9	76.6	76.4	76.1	76.4	78.1	79.2	80.5	81.3	82.3	82.3	82.7	82.7	82.5	82.0	81.5	80.8	79.4	78.6	78.3	78.1	77.7	77.5	79.4
Marquette, Mich	46.6	46.3	45.4	45.2	44.3	44.3	45.6	47.6	49.2	50.9	52.4	52.6	53.4	54.2	54.2	53.8	52.9	53.0	50.9	50.6	49.5	48.8	48.0	48.1	49.5
Memphis, Tenn........	70.9	70.2	69.5	69.1	68.5	68.0	67.5	68.3	70.5	72.1	74.0	75.8	76.9	78.3	79.3	80.1	80.1	79.6	78.1	76.9	75.0	73.8	72.8	72.0	73.6
Mt. Tamalpais, Cal..	48.5	48.3	48.0	48.1	47.5	47.4	46.9	46.9	46.4	46.8	47.9	49.6	51.9	53.8	55.3	56.1	56.5	55.4	54.1	52.5	51.2	50.0	49.4	49.0	50.3
New Orleans, La......	73.7	73.3	73.1	72.6	72.5	72.2	72.4	74.2	77.1	79.5	81.5	83.2	84.0	84.9	85.2	84.8	84.4	83.5	81.8	79.6	77.7	76.4	75.5	74.8	78.2
New York, N. Y......	56.2	55.4	54.7	54.3	54.2	54.7	55.9	57.5	59.6	61.7	63.7	65.5	66.0	66.1	66.5	65.7	64.9	63.2	62.3	61.9	60.5	59.3	58.3	57.4	60.2
Philadelphia, Pa......	58.2	57.1	56.5	55.8	55.2	55.5	57.1	60.1	62.4	64.9	67.4	68.6	70.0	70.9	71.5	71.7	70.9	69.4	66.8	64.8	62.8	61.4	60.3	59.5	63.3
Pittsburg, Pa........	61.2	60.3	59.3	58.5	57.9	57.5	58.0	60.5	62.9	65.5	66.9	68.7	70.0	70.8	71.3	71.3	71.5	70.0	69.1	67.3	65.9	64.6	63.3	62.0	64.8
Portland, Oreg........	50.4	49.4	48.4	47.6	47.0	46.5	45.9	46.0	45.3	45.7	46.9	48.3	49.8	50.9	52.7	53.7	55.1	55.7	56.7	56.4	55.5	54.2	53.3	52.0	50.6
St. Louis, Mo........	65.9	64.8	63.8	63.2	62.5	61.8	62.1	63.0	64.6	66.4	68.3	70.3	72.1	73.3	74.7	75.4	75.5	74.5	73.5	72.1	70.4	69.4	68.2	67.0	68.5
St. Paul, Minn........	55.7	54.5	53.5	52.7	51.5	50.8	50.2	51.5	53.3	55.2	57.3	59.1	60.8	62.5	63.8	64.5	65.2	65.5	65.6	63.6	62.7	61.0	59.3	57.5	58.2
Salt Lake City, Utah.	50.5	49.5	48.4	47.3	45.8	45.3	44.9	46.6	47.0	49.4	52.0	54.3	55.7	57.3	58.7	59.8	59.9	60.0	60.1	59.1	58.5	56.4	53.5	52.5	53.0
San Diego, Cal........	57.1	56.7	56.1	55.9	55.6	55.4	55.2	54.7	54.9	55.9	57.1	58.2	58.7	59.2	60.0	60.2	60.5	60.5	59.9	59.5	59.0	58.3	57.6	57.4	57.7
San Francisco, Cal...	50.0	49.3	48.9	48.5	48.2	48.0	47.8	48.1	47.8	48.8	50.9	52.8	55.0	56.0	56.7	56.9	56.7	56.8	55.7	54.5	53.7	52.5	51.3	50.5	51.9
Santa Fe, N. Mex ...	51.7	50.5	49.5	48.1	46.5	45.5	44.5	46.5	51.6	54.8	57.3	59.2	61.1	62.6	63.9	65.3	66.5	66.3	65.6	64.2	61.6	57.9	55.1	53.6	56.2
Savannah, Ga..........	70.9	70.4	69.8	69.3	68.6	68.4	70.0	72.6	76.2	79.1	81.4	82.9	83.8	84.0	83.7	82.5	80.3	78.3	76.1	74.4	73.8	72.9	72.4	71.9	75.5
Washington, D. C....	58.3	57.6	56.8	56.0	55.5	55.9	58.0	61.4	64.0	66.2	68.3	70.3	71.6	72.8	73.5	73.4	72.8	71.5	69.5	66.2	63.8	62.6	61.0	59.6	64.4
West Indies.																									
Basseterre, St. Kitts.	77.0	76.8	76.6	76.6	76.9	78.5	79.9	80.7	81.7	82.3	82.8	83.2	83.2	82.8	81.7	80.5	79.7	78.8	78.5	78.3	77.8	77.5	77.5	77.1	79.4
Bridgetown, Bar......	76.0	75.5	75.0	75.2	75.4	78.4	80.4	81.8	82.7	83.5	83.9	84.1	84.2	83.6	82.6	81.7	80.2	78.8	77.9	77.6	76.9	76.8	76.5	76.2	79.4
Cienfuegos, Cuba ...	71.9	71.0	70.1	69.6	69.1	69.4	74.0	78.4	80.8	81.5	85.8	87.2	86.4	85.0	83.9	82.6	81.7	80.1	78.5	77.7	76.3	75.1	73.9	72.8	77.7
Colon, U. S. C*........	77.9	77.2	77.0	76.4	76.2	76.0	77.1	79.6	81.8	82.9	83.5	83.6	84.0	83.6	82.6	82.2	81.4	80.0	79.7	79.7	79.2	78.6	78.3	78.1	79.9
Havana, Cuba..........	73.4	72.8	72.3	71.4	70.8	70.5	72.4	75.7	79.5	82.0	82.6	82.8	81.9	81.8	80.8	80.6	80.4	79.5	78.7	77.9	77.1	76.2	75.2	74.6	77.1
Kingston, Jamaica ..	71.7	71.4	71.1	71.0	70.7	70.7	73.1	78.3	80.9	83.6	84.6	85.1	84.2	83.0	81.9	81.3	80.6	79.3	77.6	76.3	75.1	74.2	73.8	72.4	77.1
Port of Spain, Trin..	74.0	73.3	73.0	72.5	72.1	74.3	78.1	81.8	83.8	85.6	87.5	88.0	87.5	87.1	85.9	84.3	81.8	79.3	77.9	77.7	76.9	76.3	75.7	75.0	79.6
San Juan, P. R........	73.9	73.4	73.0	72.7	72.6	74.0	77.4	80.8	81.3	82.3	83.4	83.7	83.4	83.2	82.6	82.2	81.1	79.5	78.4	77.5	76.6	76.0	75.3	75.0	78.3
Santiago de Cuba...	73.1	72.7	72.4	71.9	71.6	72.0	75.4	78.8	82.5	84.5	85.4	86.0	85.9	85.2	84.1	82.3	80.2	78.5	77.3	76.7	75.9	75.5	74.8	74.0	78.2
Santo Domingo, S. D.	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Willemstad, Curaçao	77.5	77.5	77.5	77.3	77.2	78.2	79.5	81.0	81.8	82.7	83.1	83.7	83.9	83.4	82.5	81.6	80.2	79.1	78.5	78.4	78.2	78.1	77.9	77.6	79.8

* For 20 days, station discontinued.

TABLE IV.—*Mean pressure for each hour of seventy-fifth meridian time, May, 1899.*

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midn't.	Mean.
Bismarck, N. Dak....	28.137	.139	.136	.135	.137	.139	.145	.151	.153	.154	.147	.141	.133	.124	.117	.110	.102	.096	.096	.103	.107	.119	.128	.135	.129
Boston, Mass..........	29.887	.884	.883	.887	.900	.910	.917	.918	.916	.911	.901	.890	.883	.872	.863	.861	.859	.862	.868	.881	.886	.890	.898	.889	.898
Buffalo, N. Y.........	29.195	.192	.193	.195	.201	.209	.217	.221	.222	.223	.220	.213	.208	.198	.186	.181	.176	.174	.180	.182	.190	.191	.193	.193	.198
Chicago, Ill.	29.130	.128	.129	.130	.136	.144	.150	.163	.157	.161	.160	.156	.146	.137	.130	.118	.103	.105	.107	.109	.116	.119	.121	.124	.133
Cincinnati, Ohio	29.355	.353	.354	.356	.364	.375	.387	.395	.397	.395	.392	.385	.377	.365	.353	.344	.338	.337	.339	.345	.349	.356	.357	.357	.364
Cleveland, Ohio	29.201	.197	.200	.200	.209	.221	.230	.232	.237	.236	.237	.227	.217	.208	.198	.193	.185	.180	.182	.183	.193	.198	.199	.199	.207
Detroit, Mich.........	29.235	.229	.228	.229	.232	.242	.252	.259	.264	.264	.262	.254	.245	.238	.226	.218	.214	.211	.215	.217	.228	.233	.232	.232	.236
Dodge, Kans	27.268	.272	.272	.276	.283	.286	.296	.310	.315	.317	.315	.308	.295	.282	.265	.244	.228	.218	.216	.224	.230	.243	.253	.260	.270
Eastport, Me	29.919	.915	.911	.910	.915	.922	.927	.929	.927	.925	.919	.913	.903	.895	.891	.888	.887	.891	.902	.914	.920	.921	.921	.919	.912
Galveston, Tex........	29.910	.902	.892	.887	.888	.895	.905	.914	.928	.936	.940	.941	.934	.926	.916	.904	.892	.883	.878	.881	.890	.901	.909	.911	.907
Havre, Mont...........	27.259	.259	.254	.252	.254	.252	.254	.258	.262	.265	.263	.260	.255	.247	.238	.231	.226	.223	.222	.225	.231	.238	.252	.257	.247
Independence, Cal ..	25.874	.880	.884	.883	.883	.883	.888	.896	.904	.911	.917	.916	.913	.905	.886	.874	.858	.845	.833	.826	.821	.832	.849	.865	.876
Kansas City, Mo......	28.921	.916	.914	.913	.913	.912	.928	.938	.946	.918	.946	.943	.936	.925	.915	.901	.894	.884	.880	.890	.897	.910	.922	.921	.917
Key West, Fla..........	30.016	.006	.000	.997	.000	.011	.027	.037	.042	.044	.043	.040	.030	.015	.999	.987	.982	.980	.987	.007	.018	.025	.029	.028	.015
Marquette, Mich	29.187	.188	.184	.187	.194	.197	.203	.204	.201	.197	.192	.184	.173	.168	.159	.157	.161	.160	.165	.164	.177	.182	.182	.184	.181
Memphis, Tenn........	29.575	.572	.568	.569	.575	.584	.604	.619	.622	.622	.629	.626	.615	.604	.586	.575	.564	.559	.558	.560	.567	.572	.574	.575	.586
Mt. Tamalpais, Cal .	27.550	.547	.541	.535	.530	.527	.528	.528	.539	.551	.563	.571	.577	.580	.577	.573	.566	.555	.546	.538	.528	.526	.531	.540	.548
New Orleans, La......	29.975	.965	.961	.961	.969	.978	.991	.000	.008	.009	.006	.002	.994	.985	.971	.959	.953	.946	.951	.956	.966	.976	.981	.980	.977
New York, N. Y......	29.711	.708	.710	.711	.720	.729	.740	.743	.739	.735	.726	.716	.704	.693	.677	.670	.665	.667	.677	.684	.698	.703	.706	.706	.706
Philadelphia, Pa......	29.924	.924	.923	.926	.936	.948	.956	.961	.956	.952	.943	.933	.920	.909	.895	.888	.885	.887	.894	.901	.913	.917	.919	.930	.922
Pittsburg, Pa..........	29.142	.136	.138	.140	.146	.155	.158	.160	.157	.157	.152	.141	.129	.119	.108	.103	.111	.112	.114	.121	.133	.136	.136	.140	.135
Portland, Oreg......	29.921	.921	.923	.922	.919	.916	.913	.910	.917	.926	.929	.931	.930	.928	.921	.914	.906	.898	.893	.889	.885	.886	.892	.901	.912
St. Louis, Mo..........	29.370	.367	.369	.369	.380	.383	.399	.409	.408	.404	.403	.398	.386	.375	.366	.356	.346	.340	.344	.344	.353	.367	.369	.369	.374
St. Paul, Minn.........	29.029	.025	.025	.021	.026	.032	.037	.044	.045	.046	.049	.049	.043	.035	.030	.020	.013	.010	.005	.007	.016	.025	.033	.034	.029
Salt Lake City, Utah.	25.521	.522	.517	.513	.511	.511	.514	.522	.531	.541	.546	.646	.547	.540	.528	.521	.511	.507	.504	.502	.502	.505	.517	.522	.521
San Diego, Cal........	29.904	.902	.890	.884	.878	.875	.873	.878	.885	.896	.904	.908	.916	.914	.908	.904	.895	.883	.878	.875	.877	.885	.890	.900	.892
San Francisco, Cal...	29.886	.885	.882	.876	.872	.871	.872	.877	.890	.901	.909	.912	.911	.906	.899	.892	.881	.870	.862	.855	.856	.862	.869	.880	.882
Santa Fe, N. Mex ...	23.207	.208	.206	.206	.206	.207	.211	.218	.236	.230	.231	.231	.224	.212	.200	.191	.175	.164	.160	.160	.167	.177	.194	.208	.201
Savannah, Ga..........	29.964	.957	.953	.955	.964	.976	.988	.996	.002	.003	.999	.989	.978	.964	.958	.940	.935	.938	.946	.951	.961	.969	.972	.969	.967
Washington, D. C....	29.933	.934	.935	.938	.941	.955	.964	.968	.964	.962	.955	.945	.936	.928	.906	.895	.894	.894	.898	.909	.920	.925	.928	.932	.931
West Indies.																									
Basseterre, St. Kitts.	29.966	.958	.957	.960	.972	.989	.001	.009	.014	.011	.001	.988	.975	.960	.949	.946	.952	.964	.975	.986	.996	.998	.991	.979	.979
Bridgetown, Bar......	29.927	.925	.930	.937	.948	.958	.969	.975	.975	.969	.956	.941	.922	.911	.906	.907	.916	.927	.944	.952	.961	.960	.950	.938	.942
Cienfuegos, Cuba....	29.931	.917	.910	.912	.922	.935	.950	.960	.962	.960	.948	.933	.918	.901	.885	.884	.890	.905	.924	.939	.953	.960	.959	.950	.930
Colon, U. S. C*........	29.832	.824	.815	.814	.830	.830	.849	.864	.874	.876	.868	.854	.829	.811	.792	.785	.788	.796	.810	.827	.842	.851	.852	.848	.831
Havana, Cuba..........	29.945	.935	.930	.928	.934	.946	.961	.972	.978	.982	.978	.968	.954	.940	.924	.916	.913	.918	.932	.943	.958	.967	.970	.963	.948
Kingston, Jamaica..	29.651	.638	.626	.624	.629	.643	.659	.668	.674	.672	.663	.648	.633	.618	.607	.600	.600	.607	.624	.647	.660	.675	.677	.670	.642
Port of Spain, Trin..	29.880	.875	.879	.888	.900	.917	.925	.930	.929	.919	.902	.880	.858	.844	.833	.834	.844	.857	.876	.891	.905	.910	.903	.893	.886
San Juan, P. R........	29.895	.888	.889	.895	.906	.919	.930	.937	.938	.941	.922	.908	.893	.882	.872	.872	.881	.892	.908	.922	.931	.931	.923	.911	.907
Santiago de Cuba....	29.864	.851	.844	.846	.854	.867	.879	.886	.888	.886	.877	.865	.852	.837	.826	.824	.826	.837	.849	.870	.882	.891	.892	.884	.862
Santo Domingo, S. D.	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Willemstad, Curaçao	29.825	.818	.816	.823	.832	.850	.859	.868	.868	.861	.848	.827	.804	.782	.766	.759	.765	.781	.804	.823	.843	.852	.850	.842	.823

* For 20 days, station discontinued.

TABLE V.—*Average wind movement for each hour of seventy-fifth meridian time, May, 1899.*

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
Abilene, Tex	11.0	11.8	12.5	12.4	10.9	10.1	9.5	9.5	11.5	12.8	13.2	13.6	14.0	12.8	12.8	12.4	12.7	13.4	13.5	13.1	11.3	9.9	10.5	10.5	11.9
Albany, N. Y	5.2	4.7	5.4	5.9	6.0	6.1	6.8	8.6	9.2	9.1	9.5	9.5	10.3	9.8	10.1	10.0	9.4	8.2	7.5	7.2	6.5	6.2	5.5	5.3	7.6
Alpena, Mich	6.8	6.8	7.3	7.0	7.3	7.4	8.3	10.1	11.2	11.0	11.9	12.9	14.1	14.0	13.7	14.1	13.8	12.5	11.1	9.6	8.6	7.5	7.3	6.8	10.0
Amarillo, Tex	16.8	15.5	16.4	15.7	15.4	14.5	13.5	12.5	12.7	13.8	15.4	15.6	16.9	15.8	16.6	19.0	20.3	20.6	20.7	19.4	16.6	15.3	16.3	16.2	16.3
Atlanta, Ga	7.6	6.8	6.5	6.6	6.8	6.9	6.8	6.8	8.0	7.8	8.0	7.9	8.1	9.2	9.5	9.9	10.2	8.9	8.0	7.2	7.2	7.9	8.3	8.1	7.9
Atlantic City, N. J	8.8	8.7	8.2	8.0	7.7	7.9	9.2	9.7	9.8	10.5	10.5	10.8	11.7	12.3	11.5	11.8	11.9	11.2	10.1	9.7	9.9	9.6	9.3	8.5	9.9
Augusta, Ga	4.6	4.4	4.7	4.3	3.8	3.9	4.3	5.4	6.8	7.2	7.6	8.0	8.9	8.6	9.0	9.1	9.5	8.6	7.0	5.9	5.1	4.9	4.8	5.0	6.3
Baker City, Oreg	3.8	3.7	4.0	3.9	4.9	5.2	4.9	5.2	4.6	4.1	4.1	5.0	5.8	7.1	7.0	7.8	7.8	7.2	7.2	7.4	7.1	5.9	4.5	4.2	5.5
Baltimore, Md	2.9	3.4	3.0	2.8	3.2	3.3	4.0	5.2	5.5	5.9	5.9	6.2	6.9	7.1	7.5	7.2	6.8	6.0	5.6	5.0	4.2	3.8	3.4	3.2	4.9
Bismarck, N. Dak	10.3	9.2	9.7	9.5	9.7	9.1	10.2	10.6	11.2	12.4	13.2	14.2	15.4	14.9	15.7	16.2	15.5	15.3	15.5	14.7	12.0	10.9	10.4	10.5	12.3
Block Island, R. I	9.6	9.8	9.9	11.3	11.5	10.7	11.3	12.5	12.1	12.9	13.2	14.2	14.8	16.4	16.2	15.6	16.1	15.5	13.9	12.4	12.0	11.6	10.9	10.2	12.7
Boise, Idaho	5.0	4.6	4.6	4.3	4.0	4.0	3.8	2.8	3.0	3.9	5.2	6.5	9.0	8.9	9.1	8.8	9.5	9.5	9.0	8.3	7.2	6.2	5.0	4.7	6.1
Boston, Mass	8.2	8.3	8.2	8.3	9.0	9.4	10.2	10.2	10.8	11.6	11.7	12.5	12.5	13.0	13.5	12.7	12.1	11.4	10.2	9.0	9.8	9.6	9.5	8.2	10.4
Buffalo, N. Y	9.4	10.6	10.5	10.5	11.0	11.1	10.6	10.8	10.9	11.6	12.8	13.4	14.1	13.6	13.6	13.8	13.7	13.6	12.1	11.7	11.7	11.5	11.9	11.0	11.9
Cairo, Ill	7.1	7.1	7.4	7.5	7.4	7.2	7.9	8.7	9.4	9.4	10.0	9.8	10.5	10.8	10.7	10.9	10.6	10.0	8.6	7.9	7.4	7.2	7.2	6.7	8.6
Cape Henry, Va	11.2	12.1	12.9	13.4	12.6	12.4	12.0	12.5	13.1	13.5	13.2	14.1	14.1	14.3	13.3	13.9	13.1	12.5	11.4	10.9	11.3	11.0	11.6	12.3	12.6
Carson City, Nev	6.9	6.0	4.8	5.2	4.6	4.8	4.7	5.4	5.7	5.4	6.3	7.8	8.7	9.9	11.5	12.9	14.5	15.2	14.2	14.7	12.9	11.0	8.5	7.8	8.7
Charleston, S. C	9.2	9.2	8.8	9.0	9.0	8.6	9.4	10.7	11.0	10.7	11.3	12.4	13.5	14.2	14.9	15.3	14.7	14.2	12.7	11.5	10.4	10.0	9.8	10.0	11.3
Charlotte, N. C	5.7	5.7	6.0	5.5	5.3	4.7	4.8	5.8	6.8	7.3	7.2	6.6	6.8	6.6	7.2	7.0	6.8	6.8	6.1	5.4	4.9	5.5	6.0	5.8	6.1
Chattanooga, Tenn	5.2	4.3	3.7	3.8	3.8	3.5	4.1	4.4	5.9	6.6	7.4	8.1	8.9	9.8	9.7	9.9	8.9	8.6	8.3	6.4	5.6	4.6	5.2	5.0	6.3
Cheyenne, Wyo	9.4	9.1	8.3	8.6	8.2	8.0	8.6	9.0	9.5	11.6	14.1	15.0	16.3	17.0	17.6	17.5	16.1	15.9	15.8	15.1	12.9	11.2	10.2	9.6	12.3
Chicago, Ill	15.8	15.8	15.3	15.5	16.6	16.5	15.6	16.2	16.2	17.1	18.0	18.0	19.2	20.5	20.3	20.1	19.8	19.2	17.5	16.3	16.1	15.5	15.6	16.6	17.2
Cincinnati, Ohio	5.5	4.5	5.0	4.7	4.6	5.0	5.8	6.4	7.7	9.4	9.8	9.5	9.3	9.7	10.7	10.1	9.5	9.3	8.2	7.1	6.4	5.7	5.1	4.8	7.2
Cleveland, Ohio	11.7	11.5	12.1	12.5	12.5	12.6	13.3	13.1	13.8	13.8	14.2	14.1	14.0	14.3	15.0	15.2	13.5	13.1	11.8	11.7	11.1	10.7	11.5	12.2	12.9
Columbia, Mo	8.4	8.4	7.9	7.3	7.0	7.7	6.9	7.2	8.5	8.9	9.3	10.0	10.2	10.0	10.2	9.5	9.4	8.6	8.0	7.6	7.1	8.1	8.3	8.6	8.5
Columbus, Ohio	5.9	5.6	5.6	5.3	5.2	5.7	6.2	7.5	7.9	8.7	9.4	9.6	9.5	9.8	10.0	10.0	10.0	9.7	8.7	7.5	6.7	6.9	6.2	6.3	7.7
Concordia, Kans	7.5	7.5	8.0	7.3	6.4	6.4	6.2	6.7	8.5	10.0	11.3	11.5	11.7	11.7	12.3	12.0	12.0	12.0	11.3	9.7	8.0	7.8	7.8	7.7	9.2
Davenport, Iowa	8.6	8.6	8.2	7.9	7.5	7.2	7.5	7.8	8.8	9.1	9.5	10.3	11.1	11.6	11.9	11.6	11.3	10.5	9.7	8.1	6.9	7.5	7.4	7.9	9.0
Denver, Colo	7.3	6.8	5.4	5.5	5.9	5.4	5.4	6.1	5.5	7.1	8.9	8.2	9.4	9.6	11.2	12.3	12.7	12.1	13.3	12.4	10.4	9.4	8.5	7.9	8.6
Des Moines, Iowa	10.1	9.3	8.7	8.1	7.8	8.4	7.8	8.0	9.5	10.9	12.0	12.3	13.3	13.0	12.5	12.5	12.3	12.2	12.1	10.5	8.5	7.8	8.1	8.3	10.2
Detroit, Mich	7.6	7.6	8.4	8.1	8.1	7.8	7.4	8.0	8.8	9.8	10.0	11.1	12.2	12.9	12.5	12.2	11.7	10.9	9.8	8.6	7.7	7.5	7.8	7.7	9.3
Dodge, Kans	13.9	13.9	13.1	12.7	12.2	12.2	11.1	11.3	13.7	15.8	16.3	16.2	16.4	16.9	17.5	17.5	18.5	18.8	19.0	17.6	14.7	13.7	14.3	14.7	15.1
Dubuque, Iowa	6.4	6.0	6.0	6.5	5.6	6.1	6.5	7.7	8.4	9.2	9.8	10.6	12.4	12.4	12.1	11.8	11.6	11.3	9.7	8.6	7.2	7.2	7.0	6.4	8.6
Duluth, Minn	9.6	10.0	10.2	10.4	10.5	10.8	10.5	10.8	11.9	13.0	13.5	13.8	14.4	15.4	15.9	15.3	14.5	13.6	12.8	10.9	9.7	8.6	8.4	8.8	11.8
Eastport, Me	8.8	8.5	8.4	8.5	8.5	9.2	9.8	10.1	10.3	11.0	11.1	11.4	11.8	11.5	12.0	11.8	11.9	11.2	9.5	9.2	9.0	8.3	8.1	7.9	9.9
Elkins, W. Va	3.0	2.5	2.3	2.3	2.0	1.7	1.8	2.3	3.6	4.4	5.8	6.3	7.8	7.6	8.0	7.7	7.1	7.1	5.5	4.1	3.0	2.8	2.6	3.2	4.4
El Paso, Tex	13.4	12.6	11.6	11.0	10.1	9.7	8.8	8.3	8.2	8.0	9.4	10.8	11.7	13.5	14.4	16.3	17.3	17.3	17.0	17.4	15.1	12.0	11.6	12.4	12.4
Erie, Pa	7.4	8.1	8.4	8.3	9.0	9.6	10.1	10.6	10.8	11.0	11.5	11.3	10.2	10.2	10.6	10.2	10.2	9.1	7.6	7.2	7.4	7.7	7.7	8.0	9.3
Escanaba, Mich	7.7	7.4	7.2	7.5	7.3	7.7	8.6	8.9	9.0	9.4	10.0	10.4	12.1	12.6	12.6	12.8	12.5	11.7	11.0	10.3	9.0	8.9	8.7	8.1	9.6
Eureka, Cal	7.4	6.2	5.6	6.3	5.6	6.1	5.5	4.9	4.8	5.6	6.4	7.6	9.7	11.1	12.3	13.6	13.4	13.1	12.5	12.1	11.1	10.2	8.7	7.7	8.6
Evansville, Ind	6.3	5.9	5.6	5.8	6.3	6.1	6.2	6.9	8.5	8.9	9.4	9.9	9.9	9.7	10.0	10.5	10.4	9.5	7.9	6.6	6.4	7.1	6.9	6.2	7.8
Fort Canby, Wash	11.0	9.5	8.8	9.3	8.7	8.4	9.0	10.0	10.1	10.5	10.7	10.7	11.1	11.5	12.4	12.8	13.3	13.5	13.4	13.1	11.3	11.7	10.5	10.1	10.9
Fort Smith, Ark	5.1	5.9	5.6	6.2	6.0	5.4	5.3	5.9	6.5	8.1	8.7	8.9	9.7	9.6	9.4	9.4	9.9	8.8	8.3	6.9	5.9	5.9	5.9	5.4	7.2
Fresno, Cal	10.9	10.2	9.9	8.7	8.0	7.5	6.9	6.2	5.7	6.1	6.6	6.5	6.5	6.5	6.7	7.1	7.2	7.1	7.8	8.4	8.9	8.8	9.5	10.0	7.8
Galveston, Tex	10.4	10.6	10.8	10.7	10.4	9.6	9.4	10.0	10.4	11.0	11.8	11.5	12.0	12.2	12.1	11.8	11.4	11.2	11.0	10.9	10.9	11.3	11.5	11.3	11.0
Grand Haven, Mich	8.2	8.9	9.2	9.2	8.9	8.5	8.9	9.5	10.0	11.1	11.1	11.7	11.6	12.3	12.3	11.1	10.6	10.2	9.0	7.3	6.9	7.3	7.3	8.1	9.5
Grand Junction, Colo	5.0	5.6	4.7	5.2	5.7	6.2	5.5	5.3	5.6	6.7	6.4	6.9	7.8	9.1	10.4	11.6	12.0	12.1	11.7	11.2	8.7	5.9	5.1	5.1	7.5
Green Bay, Wis	7.3	7.4	7.1	5.9	6.2	5.9	6.2	7.5	7.9	9.0	10.5	11.4	11.4	12.1	12.3	12.3	11.3	10.5	10.1	9.2	8.4	7.9	8.0	7.0	8.9
Hannibal, Mo	9.2	8.6	9.2	8.7	9.3	8.9	8.4	8.9	9.5	10.0	10.9	11.2	11.3	11.5	11.6	12.1	11.8	10.3	9.0	8.4	7.3	8.0	8.7	8.8	9.7
Harrisburg, Pa	4.5	4.4	4.0	4.1	4.8	4.8	5.1	5.5	6.1	6.5	6.5	6.8	7.3	8.0	8.2	8.3	8.4	8.1	7.2	7.0	5.6	5.1	4.8	4.6	6.1
Hatteras, N. C	9.4	9.1	9.4	10.1	11.2	11.1	11.6	13.4	14.3	14.7	14.6	14.6	14.1	14.4	14.1	13.5	12.9	12.6	11.7	11.4	11.3	11.5	11.1	10.9	12.2
Havre, Mont	9.8	9.5	9.0	9.6	10.3	9.9	9.4	10.7	11.7	12.8	13.8	13.3	14.3	15.7	16.1	16.5	16.2	16.9	16.0	15.2	13.5	12.5	11.6	10.3	12.7
Helena, Mont	8.1	7.6	7.7	8.0	7.8	7.3	7.7	7.9	7.9	7.5	7.5	8.1	9.1	9.5	10.7	11.8	11.4	10.8	10.7	10.9	10.0	9.3	8.7	9.0	9.0
Huron, S. Dak	11.8	12.1	12.4	12.4	12.3	12.0	11.2	12.4	14.1	15.7	16.6	16.9	17.3	18.3	17.4	18.2	18.1	16.8	15.7	14.4	12.0	10.9	10.8	11.4	14.2
Idaho Falls, Idaho	9.7	10.3	9.5	10.0	9.5	9.2	8.7	8.9	9.8	11.6	12.5	13.6	14.3	14.2	14.8	15.4	16.2	16.5	16.3	16.5	15.9	13.0	11.5	10.3	12.4
Independence, Cal	12.9	11.5	10.5	11.5	10.8	10.6	9.8	9.1	8.6	8.9	10.6	10.1	10.0	9.8	10.3	12.1	13.2	13.1	13.5	14.1	14.2	13.1	12.5	13.2	11.4
Indianapolis, Ind	7.8	8.0	7.6	7.6	7.9	8.5	8.4	9.3	10.1	10.6	11.3	12.0	12.2	13.0	13.3	12.4	11.4	11.2	11.0	9.0	8.1	7.7	7.5	7.6	9.7
Jacksonville, Fla	6.6	6.6	6.0	6.5	6.1	5.9	6.5	7.2	7.5	7.7	7.7	8.6	8.0	8.9	9.5	10.4	10.2	9.7	8.9	7.4	6.5	6.3	6.3	6.3	7.6
Jupiter, Fla	8.1	7.5	7.5	7.4	7.3	6.9	7.0	7.6	7.8	8.4	9.2	9.9	10.4	11.5	12.0	12.0	11.3	11.0	9.9	9.9	9.5	9.2	8.6	8.1	9.1
Kansas City, Mo	8.8	8.5	8.6	8.8	8.8	8.7	7.3	7.3	8.5	9.3	9.9	10.0	11.2	11.4	11.5	11.9	12.2	11.8	10.6	9.5	9.2	8.9	9.1	8.5	9.6
Keokuk, Iowa	7.4	7.0	8.0	7.4	7.1	6.9	7.2	7.9	8.3	8.6	8.9	9.7	9.9	10.0	10.1	9.0	9.4	9.0	8.0	7.1	6.7	6.8	7.1	6.5	8.1
Key West, Fla	7.1	6.6	6.5	6.2	6.4	6.3	6.8	7.6	8.1	8.4	8.4	8.2	8.4	8.1	7.8	7.4	7.4	7.4	7.4	7.1	6.8	6.6	6.9	6.7	7.3
Kittyhawk, N. C	10.7	11.4	11.1	12.0	13.3	13.9	14.1	15.4	15.1	15.7	16.0	14.1	13.5	14.1	14.0	14.8	15.2	14.8	13.7	12.9	12.4	12.9	12.6	11.3	13.5
Knoxville, Tenn	5.9	5.3	4.9	5.0	4.5	4.5	4.6	5.3	5.9	6.3	7.4	7.6	8.3	8.6	8.9	9.4	8.9	8.2	7.1	6.6	6.0	6.0	6.4	6.1	6.6
La Crosse, Wis	6.0	5.7	5.6	6.3	6.2	6.1	6.0	6.1	7.6	7.9	8.7	9.8	10.2	10.4	10.9	9.9	9.8	9.6	9.6	8.5	7.2	6.2	5.9	6.0	7.8
Lander, Wyo	3.8	3.8	3.4	3.0	2.5	2.6	2.9	3.3	3.2	4.1	4.4	4.8	5.5	6.3	8.3	9.7	9.7	10.6	9.8	9.3	7.4	6.6	5.0	4.5	5.6
Lexington, Ky	7.5	8.2	8.2	8.2	8.1	8.3	8.1	8.1	8.8	9.9	9.6	10.1	9.8	10.3	10.1	9.9	10.0	9.5	8.0	7.1	6.9	6.8	7.6	7.4	8.6
Little Rock, Ark	6.1	5.9	5.7	6.0	6.4	6.8	6.2	6.8	7.4	8.9	8.9	9.1	9.3	9.8	9.8	9.5	8.8	8.5	7.2	6.7	5.8	6.0	6.1	5.0	7.4
Los Angeles, Cal	2.1	2.2	2.2	2.3	1.9	2.0	1.8	2.1	2.0	2.7	3.2	3.5	4.5	5.3	6.9	8.6	9.3	9.3	8.8	8.5	7.6	5.9	4.1	2.8	4.6
Louisville, Ky	6.2	6.3	6.4	5.9	5.8	5.9	5.6	6.3	8.4	8.7	9.5	10.0	11.1	11.5	10.5	10.0	10.3	9.8	8.6	7.7	7.1	7.1	6.6	6.1	8.0
Lynchburg, Va	1.8	1.5	1.5	1.6	1.5	1.5	1.7	2.5	3.7	3.9	4.4	4.7	5.5	5.6	5.9	5.5	5.3	4.7	3.7	3.6	2.8	1.9	2.3	1.9	3.3
Macon, Ga	4.5	4.7	4.3	3.9	3.7	3.5	3.8	4.6	6.1	6.6	6.8	7.5	7.7	7.5	7.7	8.1	8.0	7.3	6.4	5.2	5.1	4.4	4.8	4.2	5.7
Marquette, Mich	8.4	9.1	8.7	8.1	9.3	8.8	8.5	9.5	10.1	11.0	10.8	12.3	12.3	12.1	12.3	12.2	10.7	9.3	7.7	6.8	6.3	7.2	7.1	8.0	9.4
Memphis, Tenn	8.3	8.5	8.5	8.8	9.8	9.5	9.4	8.3	9.7	10.5	10.3	10.7	11.5	11.0	11.7	12.1	10.4	10.4	8.5	7.2	7.0	7.5	7.7	8.1	9.4
Milwaukee, Wis	10.1	9.6	9.7	8.9	8.8	8.3	8.8	9.1	10.1	10.9	11.8	12.3	12.9	13.5	13.2	13.5	13.7	13.1	11.6	11.1	9.9	9.0	9.8	10.4	10.8
Minneapolis, Minn	12.5	12.8	11.7	11.9	12.0	11.0	11.9	11.7	12.9	13.8	14.6	14.9	15.8	15.8	16.3	16.2	15.4	14.7	14.7	12.9	12.2	11.4	11.8	12.3	13.4
Mobile, Ala	5.5	4.9	4.8	4.5	4.7	3.7	3.9	4.0	5.7	6.4	7.5	8.6	10.4	11.9	13.1	14.7	14.0	12.8	10.9	8.8	7.3	6.7	6.3	5.9	7.8
Montgomery, Ala	5.1	5.5	5.5	5.1	4.8	4.7	4.2	5.0	6.5	6.9	6.7	7.3	7.9	7.8	8.2	8.6	9.0	8.0	7.5	5.5	5.2	4.8	5.1	4.8	6.2
Moorhead, Minn	9.6	10.0	9.6	9.8	10.6	10.5	9.9	10.1	11.8	13.5	14.5	13.8	14.4	14.7	14.0	14.0	14.0	13.4	13.4	12.2	9.8	8.7	9.3	8.5	11.7
Mount Tamalpais, Cal	33.0	30.9	29.6	28.4	28.3	27.5	27.3	25.0	23.0	20.5	17.4	14.2	11.7	10.3	11.3	12.5	13.9	16.5	20.6	23.7	26.5	30.7	33.9	34.0	22.9
Nantucket, Mass	8.9	9.4	9.8	10.1	10.4	11.0	11.3	12.5	12.9	13.3	13.6	13.5	13.3	13.5	13.4	12.6	12.5	12.0	10.3	9.6	9.2	8.6	8.7	9.1	11.2
Nashville, Tenn	4.6	4.3	4.5	3.9	3.5	3.9	3.9	5.2	6.4	7.5	8.2	7.9	8.3	9.2	9.3	9.5	9.1	8.2	7.0	6.0	5.7	5.4	4.9	4.9	6.3
Neah, Wash	4.4	4.5	4.4	4.8	4.9	4.5	4.2	4.4	4.1	4.0	5.3	6.6	6.7	7.8	8.3	9.6	11.0	10.9	9.8	10.1	9.3	7.6	6.2	5.0	6.6
New Haven, Conn	6.1	5.4	5.2	5.4	5.4	5.7	6.5	8.2	9.1	10.0	10.4	10.9	12.1	11.9	11.3	11.2	10.0	9.4	8.3	7.5	6.6	6.3	6.1	5.9	8.1
New Orleans, La	5.9	5.6	5.7	5.4	4.8	4.5	4.3	5.2	6.9	8.1	8.5	8.7	9.8	9.5	9.6	10.4	10.6	11.1	10.6	9.6	8.0	7.3	6.9	6.2	7.6

TABLE V.—*Average wind movement, etc.*—Continued.

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
New York, N. Y	10.7	11.1	11.0	10.3	10.5	9.5	9.7	11.1	11.4	11.2	11.1	11.7	13.1	13.9	14.1	15.5	15.8	14.9	14.4	13.2	12.8	12.7	11.5	11.0	12.2
Norfolk, Va	7.4	7.2	7.2	7.5	7.2	6.2	7.5	8.3	9.4	9.9	10.0	9.7	10.0	10.6	11.5	11.2	10.6	10.0	9.4	8.1	8.3	8.2	7.8	7.3	8.8
Northfield, Vt	6.2	6.4	6.5	6.1	6.5	6.1	6.3	8.2	11.0	12.0	12.8	12.8	13.2	13.4	12.8	12.9	12.1	10.2	7.2	6.8	6.8	6.9	7.1	7.0	9.1
North Platte, Nebr	11.2	11.0	10.2	9.5	9.5	9.5	8.7	8.2	9.6	10.4	10.7	11.0	11.7	12.3	13.1	13.1	13.4	14.1	13.8	13.8	12.0	11.5	11.8	11.8	11.3
Oklahoma, Okla	11.3	9.9	9.7	9.8	9.7	10.0	10.5	12.3	13.4	14.1	14.4	14.4	13.6	13.9	13.9	13.6	13.8	13.7	12.2	11.7	10.9	10.9	11.4	12.2	12.1
Omaha, Nebr	8.4	9.5	9.3	8.0	7.8	7.6	6.6	7.6	8.8	9.9	10.2	11.2	11.4	11.7	11.7	11.8	11.7	11.5	10.7	10.6	9.6	8.9	8.6	8.7	9.7
Oswego, N. Y	7.8	7.8	7.5	7.7	7.9	7.9	8.0	8.7	8.5	8.7	8.9	9.2	9.1	9.5	9.4	9.3	8.5	7.7	6.6	6.9	7.1	7.8	7.6	7.2	8.1
Palestine, Tex	7.6	7.8	7.3	6.6	6.5	6.3	6.0	6.6	7.5	8.6	9.5	9.6	9.7	9.9	10.0	10.4	10.1	9.6	8.3	6.2	5.6	7.1	7.6	7.8	8.0
Parkersburg, W. Va	3.2	3.1	2.5	2.7	2.6	2.7	3.2	3.8	5.5	5.9	6.3	6.5	7.5	7.9	7.2	7.5	7.0	6.7	5.8	4.9	4.3	4.0	3.7	3.5	4.9
Pensacola, Fla	8.5	8.2	7.9	7.5	7.3	7.3	6.1	5.8	8.0	9.3	9.3	10.1	11.7	12.1	13.1	13.7	13.6	13.6	12.5	11.5	9.5	8.6	8.7	9.1	9.7
Phenix, Ariz	3.8	3.5	3.2	3.8	3.7	3.6	4.6	4.6	4.9	5.0	4.5	4.3	4.8	5.3	6.2	6.7	7.1	7.3	7.0	6.7	5.0	4.4	4.2	4.2	4.9
Philadelphia, Pa	7.3	7.2	7.9	7.7	7.4	7.4	8.1	9.2	9.8	10.1	9.9	10.0	11.0	11.4	11.4	11.3	11.8	12.1	11.1	10.0	8.9	8.2	7.9	7.3	9.3
Pierre, S. Dak	15.6	16.6	15.4	14.9	14.9	13.9	13.8	13.7	14.8	16.7	17.5	17.5	18.0	18.5	19.0	18.2	18.6	18.2	18.3	18.4	16.5	16.2	15.8	15.4	16.5
Pittsburg, Pa	4.5	3.8	3.8	3.3	3.6	3.8	4.5	4.8	5.6	6.5	6.7	6.4	7.3	7.0	6.7	7.0	6.8	6.5	5.7	5.3	4.9	4.4	4.1	4.9	5.3
Point Reyes Lt., Cal	31.7	31.5	31.3	31.1	30.5	30.3	30.5	29.3	28.0	27.1	26.3	25.2	25.2	25.1	24.3	24.7	26.1	26.9	27.9	29.0	30.6	32.2	31.5	31.1	28.6
Port Crescent, Wash	3.5	3.7	3.4	3.3	3.0	2.9	2.8	2.7	2.3	2.4	4.1	4.9	6.1	7.0	7.6	7.6	6.9	6.8	6.6	6.9	6.2	5.5	4.9	4.0	4.8
Port Huron, Mich	8.2	9.2	9.2	9.8	10.3	9.6	9.3	9.7	10.2	10.7	11.2	11.9	12.4	13.5	13.6	13.1	12.9	11.0	9.4	8.7	8.3	8.2	8.4	8.5	10.3
Portland, Me	6.1	6.1	6.2	6.0	6.3	6.0	6.5	7.9	7.9	9.4	9.5	10.8	10.6	10.7	10.9	11.1	10.0	9.4	8.4	7.0	6.5	6.8	6.3	6.2	8.0
Portland, Oreg	6.1	6.2	5.1	5.2	5.4	6.0	6.2	6.0	6.0	6.0	7.1	7.3	7.5	6.9	6.8	7.3	7.1	7.8	7.9	8.2	8.4	9.2	8.2	6.4	6.8
Pueblo, Colo	6.8	6.7	6.4	5.1	4.8	5.3	5.2	5.0	5.1	6.9	7.4	7.6	9.4	10.1	12.0	12.9	13.4	13.9	15.5	14.1	12.4	10.2	9.8	8.7	9.0
Raleigh, N. C	4.9	4.6	5.1	5.4	4.9	4.9	4.8	5.3	5.9	6.0	6.2	6.2	6.4	6.5	6.2	5.7	6.1	5.5	5.1	3.7	3.9	4.1	4.4	4.6	5.3
Rapid City, S. Dak	8.7	8.1	7.5	7.2	6.8	6.9	7.2	6.9	7.3	8.1	9.3	9.8	10.7	11.3	11.5	12.4	13.5	11.6	11.8	11.1	9.6	8.0	7.4	8.6	9.2
Red Bluff, Cal	7.1	6.8	7.0	6.3	6.4	6.2	6.4	6.3	6.5	6.4	8.5	8.8	9.2	8.7	8.2	8.2	8.3	7.8	8.3	8.2	8.0	7.9	8.0	7.5	7.5
Richmond, Va	4.6	4.8	4.7	5.2	4.9	4.7	5.4	5.9	6.7	7.4	7.5	7.3	7.5	7.7	8.0	8.3	8.2	7.5	7.0	6.4	5.6	5.9	4.5	4.4	6.3
Rochester, N. Y	5.2	5.3	5.5	5.7	6.4	5.7	6.2	6.8	7.3	7.3	7.7	8.2	9.5	9.9	10.4	9.4	8.9	8.2	7.2	6.2	5.9	5.7	6.1	5.7	7.1
Roseburg, Oreg	2.7	2.5	2.2	2.3	2.5	2.5	2.2	2.5	2.4	2.3	3.2	3.9	4.5	4.6	5.4	5.7	5.7	7.0	6.3	7.3	7.1	6.3	4.5	3.7	4.1
Sacramento, Cal	8.9	8.7	8.7	8.9	8.4	8.5	7.6	7.7	7.0	7.1	7.7	8.2	8.9	9.2	10.0	10.5	10.6	11.4	12.1	12.8	12.3	11.4	10.4	9.8	9.5
St. Louis, Mo	7.6	8.7	8.6	8.8	8.5	8.3	7.4	7.7	8.8	9.9	10.3	10.1	10.5	10.4	10.2	9.5	9.7	9.3	8.9	8.4	8.4	8.2	8.7	8.3	9.0
St. Paul, Minn	6.8	6.5	6.3	6.6	6.7	6.3	7.0	7.8	9.0	9.9	10.5	11.0	11.0	12.1	12.3	12.2	11.9	11.0	10.6	9.8	8.0	7.0	7.5	7.4	9.0
Salt Lake City, Utah	4.4	4.7	4.6	4.5	4.3	4.2	4.1	3.5	3.4	4.6	6.6	8.3	10.9	11.1	11.5	10.9	11.9	11.2	9.6	8.5	6.2	4.9	5.2	4.0	6.8
San Antonio, Tex	11.1	9.6	9.4	9.4	8.8	8.0	7.7	7.3	9.3	11.2	12.2	12.5	13.4	12.9	13.9	13.5	13.8	14.0	14.9	13.9	14.1	14.5	13.1	11.8	11.7
San Diego, Cal	4.0	3.3	3.6	4.2	4.0	3.8	3.9	3.7	4.1	4.6	5.0	6.3	8.5	9.3	10.0	10.1	10.5	10.4	9.9	9.0	7.9	6.2	5.3	4.2	6.3
Sandusky, Ohio	6.9	7.2	7.4	7.7	8.1	8.0	8.4	9.2	9.1	8.9	9.0	9.4	9.5	10.1	10.0	9.2	9.2	8.2	7.9	7.9	7.5	7.1	6.9	6.9	8.3
Sandy Hook, N. J	9.2	8.8	9.4	8.9	8.5	8.4	7.9	7.9	7.6	7.5	7.7	7.9	8.2	9.7	10.7	10.8	10.5	9.3	10.0	9.6	9.5	9.8	10.0	9.0	9.0
San Francisco, Cal	13.6	12.5	11.0	10.7	9.8	8.8	7.9	7.2	6.5	7.4	7.8	8.6	10.2	12.6	15.7	19.7	21.3	23.4	22.4	22.7	21.7	19.4	17.2	15.6	13.9
San Luis Obispo, Cal	2.9	2.5	2.5	2.3	2.0	2.4	2.1	2.3	2.5	2.8	3.9	4.4	5.4	7.1	9.1	10.6	11.2	11.5	10.9	10.7	9.8	7.9	5.7	4.2	5.7
Santa Fe, N. Mex	4.5	4.5	4.5	4.6	4.4	4.3	3.9	4.6	4.7	6.2	7.8	9.9	11.2	12.5	13.4	14.6	15.0	15.5	14.3	13.1	10.8	7.5	6.0	5.0	8.5
Sault Ste. Marie, Mich	7.1	6.8	7.3	7.5	8.2	8.8	8.9	9.8	10.9	12.2	12.9	14.0	14.6	14.9	14.8	14.7	14.5	12.9	11.6	9.7	9.0	7.6	6.7	6.1	10.5
Savannah, Ga	7.4	7.1	6.0	5.7	5.7	6.0	6.3	8.0	8.4	8.5	9.1	9.4	10.7	10.6	11.4	12.3	12.2	11.4	9.5	8.4	8.1	8.0	7.8	7.8	8.6
Seattle, Wash	4.8	5.1	5.1	5.0	5.1	5.2	5.5	5.1	5.3	5.8	6.2	6.1	6.9	7.5	7.5	7.6	7.4	7.3	7.4	6.9	6.4	5.7	5.3	4.6	6.0
Shreveport, La	6.8	6.4	6.1	6.2	5.6	5.1	5.1	5.3	6.1	7.3	7.7	7.3	8.1	8.6	9.0	8.5	8.6	8.1	7.5	6.8	6.5	6.1	6.2	6.8	6.9
Sioux City, Iowa	14.1	13.5	13.4	13.4	13.1	13.5	13.5	15.2	15.3	16.6	16.8	18.1	19.2	18.4	17.9	18.5	17.0	16.1	15.5	15.2	14.2	14.1	13.9	13.8	15.4
Spokane, Wash	6.5	6.5	5.8	6.0	5.9	5.9	5.9	6.5	6.9	6.8	7.5	8.3	8.5	8.2	8.7	8.8	9.1	9.0	8.6	8.5	8.2	7.3	6.5	6.4	7.3
Springfield, Ill	8.9	8.9	8.5	8.7	9.4	9.2	8.6	8.7	8.8	9.9	10.2	10.6	10.7	11.8	12.1	12.2	11.6	10.5	9.4	7.6	7.9	7.5	8.7	8.8	9.6
Springfield, Mo	10.2	9.9	10.1	10.4	10.5	10.5	10.2	10.8	11.9	13.4	14.3	14.2	13.9	13.1	12.7	11.5	11.3	11.3	11.4	10.5	10.3	9.5	10.5	10.5	11.4
Tacoma, Wash	5.0	5.1	4.8	5.0	4.5	4.8	4.2	4.1	4.6	5.2	5.3	6.2	6.5	6.5	6.7	7.1	6.9	6.8	6.8	6.2	6.4	5.7	5.2	4.9	5.6
Tampa, Fla	3.6	3.7	3.7	3.5	3.6	3.5	3.5	5.0	6.4	6.7	7.3	7.7	7.7	8.6	9.0	9.5	9.2	8.5	7.5	5.7	4.9	4.7	4.2	3.8	5.9
Toledo, Ohio	8.0	8.7	8.7	8.4	8.0	8.1	8.1	8.9	9.7	9.8	10.8	11.8	12.5	13.1	12.1	11.8	11.2	10.6	9.7	9.0	8.7	8.4	7.7	8.0	9.7
Vicksburg, Miss	7.4	6.8	6.6	5.7	5.5	5.2	5.0	5.4	6.3	6.3	7.2	7.5	8.1	8.2	8.1	7.9	7.5	6.7	5.3	4.8	5.2	5.5	6.1	6.9	6.5
Vineyard Haven, Mass	7.0	6.4	6.5	6.6	6.7	7.4	8.5	9.4	9.8	10.4	10.4	10.9	11.3	11.2	11.1	11.0	10.3	9.6	8.5	7.4	7.1	6.6	6.7	6.8	8.6
Walla Walla, Wash	5.7	6.0	6.5	6.6	7.2	6.9	6.5	6.6	6.0	6.5	7.8	7.4	8.1	7.7	7.3	7.5	6.8	6.7	6.6	6.8	7.1	6.3	5.4	5.3	6.7
Washington, D. C	3.9	4.0	3.8	3.7	4.3	3.9	4.0	5.2	6.5	7.5	7.3	7.5	7.6	8.0	8.7	8.7	7.9	7.3	6.5	5.6	5.5	4.7	4.2	3.8	5.8
Wichita, Kans	9.6	9.9	9.2	8.9	9.5	8.5	8.4	8.9	9.8	11.0	11.6	11.8	12.1	12.6	13.2	13.1	13.4	12.8	13.0	11.9	9.8	9.7	10.2	10.1	10.8
Williston, N. Dak	11.0	10.7	10.5	10.8	10.6	10.1	10.6	11.1	12.5	14.8	16.0	17.0	18.5	18.9	19.9	20.2	19.6	18.4	18.9	17.1	13.6	10.9	10.9	11.5	14.3
Wilmington, N. C	5.9	6.0	5.7	5.4	5.7	6.0	6.5	7.8	8.5	8.7	9.3	9.4	9.2	9.6	10.3	11.2	11.1	10.1	8.4	7.8	7.1	6.4	6.7	5.9	7.8
Winnemucca, Nev	7.0	7.3	7.9	7.3	7.3	7.2	8.2	8.4	7.3	7.6	8.7	9.4	10.9	10.4	11.5	12.5	12.7	12.3	11.5	11.8	10.5	9.3	7.0	7.5	9.2
Woods Hole, Mass	10.7	10.4	11.1	12.0	12.1	12.1	13.2	14.5	14.4	13.9	15.2	15.4	16.2	16.1	15.6	15.6	14.3	14.1	12.8	11.9	11.0	10.7	10.8	11.1	13.1
Yankton, S. Dak	11.3	11.4	9.8	9.5	10.5	10.9	10.5	10.7	11.5	11.7	12.5	13.3	14.7	14.2	14.2	13.6	13.7	12.6	12.0	11.4	10.2	9.9	9.4	9.7	11.6
West Indies.																									
Basseterre, St. Kitts	7.7	7.9	7.7	7.9	8.2	8.9	10.2	11.0	11.8	11.6	12.1	11.9	11.1	10.9	10.4	10.0	9.3	8.4	8.3	8.9	8.6	8.7	8.5	8.2	9.5
Bridgetown, Bar	6.6	6.3	6.2	5.9	6.1	7.1	11.2	13.6	14.5	15.8	15.9	15.2	14.6	15.1	14.3	13.2	12.1	9.2	7.4	7.2	6.8	7.1	7.4	6.8	10.2
Cienfuegos, Cuba	5.5	5.3	5.2	5.5	5.2	5.1	4.7	5.9	6.7	7.3	8.0	8.0	9.1	10.0	10.2	9.9	8.4	7.5	6.4	6.5	5.6	5.7	5.8	5.8	6.8
Colon, U. S. C.*	6.6	6.3	6.2	6.4	5.8	5.8	5.8	6.1	6.6	7.2	7.5	7.7	8.0	8.2	8.6	8.4	7.8	7.6	7.3	7.5	7.2	7.2	6.9	6.9	7.1
Havana, Cuba	5.6	5.5	5.1	4.9	4.4	4.8	4.5	6.2	9.8	10.9	13.2	16.0	17.4	18.8	19.1	18.7	18.0	17.1	16.2	13.3	11.2	9.8	8.1	6.8	11.1
Kingston, Jamaica	4.6	4.9	5.0	5.1	5.3	5.5	4.6	3.5	3.4	3.7	6.8	9.4	12.1	12.0	11.3	9.4	8.1	5.6	4.4	4.0	4.3	4.5	4.7	4.7	6.1
San Juan, Porto Rico	2.5	2.5	2.2	2.5	2.3	2.3	2.6	4.2	6.2	7.8	9.4	9.7	10.1	10.0	9.3	8.6	7.3	6.3	5.1	4.2	3.7	3.1	2.7	2.3	5.3
Santiago de Cuba	3.9	3.4	3.5	3.6	3.2	3.3	3.8	5.5	5.7	5.3	5.7	6.9	8.5	8.2	7.8	7.5	6.3	5.1	3.5	3.4	3.8	3.8	4.1	3.8	5.0
Willemstad, Curaçao	10.9	11.4	11.1	11.1	11.3	11.4	13.6	15.4	16.3	16.6	17.1	16.7	16.8	16.6	17.2	16.4	15.8	14.8	13.7	13.4	13.0	12.7	12.1	11.1	14.0

*For 20 days.

TABLE VI.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of May*, 1899.

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
New England.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Eastport, Me	26	21	21	18	n. 31 e.	6
Portland, Me	24	21	11	22	n. 75 w.	11
Northfield, Vt	20	32	3	7	s. 34 w.	7
Boston, Mass	18	20	14	24	s. 79 w.	10
Nantucket, Mass	18	21	18	23	s. 59 w.	6
Woods Hole, Mass.*	19	23	12	23	s. 70 w.	12
Block Island, R. I	18	19	13	26	s. 86 w.	13
New Haven, Conn	17	21	14	22	s. 42 w.	12
Middle Atlantic States.						
Albany, N. Y	24	26	8	13	s. 68 w.	5
Binghamton, N. Y.†	16	6	5	11	n. 31 w.	12
New York, N. Y	17	20	19	24	s. 59 w.	6
Harrisburg, Pa.†	5	8	13	11	s. 34 e.	4
Philadelphia, Pa	17	21	14	23	s. 66 w.	10
Atlantic City, N. J	14	27	15	22	s. 28 w.	15
Cape May, N. J	16	28	17	14	s. 14 e.	12
Baltimore, Md	18	22	18	18	s.	4
Washington, D. C	18	25	15	15	s.	7
Lynchburg, Va	16	17	25	19	s. 80 e.	6
Norfolk, Va	16	27	22	9	s. 50 e.	17
Richmond, Va	20	24	17	10	s. 60 e.	8
South Atlantic States.						
Charlotte, N. C	17	24	23	13	s. 55 e.	12
Hatteras, N. C	27	16	21	12	n. 39 e.	14
Raleigh, N. C	20	18	16	14	n. 45 e.	3
Wilmington, N. C	16	18	24	17	s. 74 e.	3
Charleston, S. C	14	26	21	15	s. 27 e.	13
Augusta, Ga	13	24	16	24	s. 36 w.	14
Savannah, Ga	11	29	15	17	s. 6 w.	18
Jacksonville, Fla	12	21	26	18	s. 42 e.	12
Florida Peninsula.						
Jupiter, Fla	14	19	29	12	s. 54 e.	9
Key West, Fla	16	8	46	2	n. 80 e.	45
Tampa, Fla	17	4	19	30	n. 40 w.	17
Eastern Gulf States.						
Atlanta, Ga	16	21	19	20	s. 11 w.	5
Macon, Ga †	9	9	8	10	w.	2
Pensacola, Fla	6	8	10	14	s. 63 w.	4
Mobile, Ala	16	33	5	16	s. 33 w.	20
Montgomery, Ala	17	19	13	22	s. 77 w.	9
Meridian, Miss.†	5	16	8	12	s. 20 w.	12
Vicksburg, Miss	9	32	25	14	s. 26 e.	26
New Orleans, La	5	48	12	11	s. 1 e.	43
Western Gulf States.						
Shreveport, La	4	42	23	6	s. 24 e.	42
Fort Smith, Ark	6	19	38	6	s. 68 e.	34
Little Rock, Ark	13	32	34	11	s. 50 e.	30
Corpus Christi, Tex	1	42	43	0	s. 46 e	59
Fort Worth, Tex†	2	20	8	5	s. 14 e.	18
Galveston, Tex	2	46	34	2	s. 36 e.	54
Palestine, Tex	7	42	16	10	s. 10 e.	36
San Antonio, Tex	3	39	41	1	s. 48 e.	54
Ohio Valley and Tennessee.						
Chattanooga, Tenn	13	34	11	18	s. 18 w.	22
Knoxville, Tenn	19	19	19	22	w.	3
Memphis, Tenn	17	29	11	18	s. 30 w.	14
Nashville, Tenn	16	26	20	16	s. 22 e.	11
Lexington, Ky.†	4	15	10	8	s. 10 e.	11
Louisville, Ky	19	26	19	14	s. 36 e	9
Evansville, Ind.†	9	12	10	3	s. 67 e.	8
Indianapolis, Ind	17	26	18	19	s. 6 w.	9
Cincinnati, Ohio	16	25	19	15	s. 24 e.	10
Columbus, Ohio	19	21	17	22	s. 68 w.	5
Pittsburg, Pa	18	23	12	20	s. 58 w.	9
Parkersburg, W. Va	21	24	17	18	s. 18 w.	3
Elkins, W. Va	22	20	10	18	n. 76 w.	8
Lower Lake Region.						
Buffalo, N. Y	9	21	15	29	s. 43 w.	19
Oswego, N. Y	12	24	15	24	s. 37 w.	15
Rochester, N. Y	12	20	14	34	s. 68 w.	22
Erie, Pa	21	17	16	25	n. 66 w.	10
Cleveland, Ohio	21	23	17	14	s. 56 e.	4
Sandusky, Ohio	14	18	24	20	s. 45 e.	6
Toledo, Ohio	18	19	20	17	s. 72 e.	3
Detroit, Mich	21	18	21	19	n. 34 e.	4
Upper Lake Region.						
Alpena, Mich	19	18	21	17	n. 63 e.	4
Escanaba, Mich	24	22	17	11	n. 72 e.	6
Grand Haven, Mich	12	18	19	19	s.	6
Marquette, Mich	29	16	11	22	n. 40 w.	17
Port Huron, Mich	30	21	10	8	n. 13 e.	9
Sault Ste. Marie, Mich	8	8	29	25	e.	4
Chicago, Ill	16	20	25	18	s. 60 e.	8
Milwaukee, Wis	22	16	22	19	n. 27 e.	7
Green Bay, Wis	18	22	20	16	s. 45 e.	6
Duluth, Minn	35	5	28	13	n. 27 e.	34
North Dakota.						
Moorhead, Minn	19	18	27	16	n. 85 e.	11
Bismarck, N. Dak	16	13	27	17	n. 73 e.	10
North Dakota—Continued.						
Williston, N. Dak	16	18	24	19	s. 68 e.	5
Upper Mississippi Valley.						
St. Paul, Minn	14	21	27	16	s. 58 e.	13
La Crosse, Wis. †	7	16	7	6	s. 6 e.	9
Davenport, Iowa	13	21	23	18	s. 32 e.	9
Des Moines, Iowa	11	28	22	17	s. 16 e.	18
Dubuque, Iowa	12	22	27	16	s. 40 e.	17
Keokuk, Iowa	12	28	22	18	s. 14 e.	16
Cairo, Ill	17	16	18	11	n. 83 e.	8
Springfield, Ill	9	29	10	15	s. 14 w.	21
Hannibal, Mo.†	2	15	12	6	s. 25 e.	14
St. Louis, Mo	15	31	17	7	s. 32 e.	19
Missouri Valley.						
Columbia, Mo.*	5	13	15	6	s. 48 e.	12
Kansas City, Mo	17	25	30	9	s. 69 e.	24
Springfield, Mo	9	35	21	7	s. 28 e.	30
Lincoln, Nebr	14	26	29	10	s. 58 e.	22
Omaha, Nebr	13	25	28	10	s. 56 e.	22
Sioux City, Iowa†	6	8	14	8	s. 72 e.	6
Pierre, S. Dak	17	16	27	15	n. 85 e.	12
Huron, S. Dak	16	16	24	20	e.	4
Yankton, S. Dak †	7	7	13	10	e.	3
Northern Slope.						
Havre, Mont	13	12	24	26	n. 63 w.	2
Miles City, Mont	17	11	23	13	n. 59 e.	12
Helena, Mont	14	23	4	38	s. 75 w.	35
Kalispell, Mont §	22	17	8	24	n. 74 w.	19
Rapid City, S. Dak	14	18	20	26	s. 56 w.	7
Cheyenne, Wyo	21	18	8	26	n. 81 w.	18
Lander, Wyo	14	22	13	32	s. 67 w.	21
North Platte, Nebr	16	25	19	20	s. 6 w.	9
Middle Slope.						
Denver, Colo	21	22	8	29	s. 87 w.	21
Pueblo, Colo	7	19	14	27	s. 47 w.	18
Concordia, Kans	10	28	19	13	s. 18 e.	20
Dodge, Kans	16	26	24	13	s. 48 e.	15
Wichita, Kans	13	39	17	3	s. 28 e.	30
Oklahoma, Okla	12	36	18	3	s. 32 e.	28
Southern Slope.						
Abilene, Tex	2	44	28	6	s. 28 e.	47
Amarillo, Tex	6	34	16	20	s. 8 w.	28
Southern Plateau.						
El Paso, Tex	18	9	7	42	n. 76 w.	36
Santa Fe, N. Mex	10	29	18	24	s. 18 w.	20
Flagstaff, Ariz	16	22	3	37	s. 80 w.	34
Phenix, Ariz	17	4	26	25	n. 4 e.	13
Yuma, Ariz	15	14	5	40	n. 88 w.	25
Independence, Cal	24	13	8	33	n. 66 w.	27
Middle Plateau.						
Carson City, Nev	18	19	5	34	s. 88 w.	29
Winnemucca, Nev	18	21	11	27	s. 79 w.	16
Salt Lake City, Utah	18	19	23	17	s. 80 e.	6
Grand Junction, Colo	15	21	21	19	s. 18 e.	6
Northern Plateau.						
Baker City, Oreg	25	25	14	15	w.	1
Boise, Idaho	10	16	18	29	s. 61 w.	12
Idaho Falls, Idaho	8	41	4	18	s. 23 w.	36
Spokane, Wash	7	36	14	17	s. 6 w.	29
Walla Walla, Wash	5	47	1	14	s. 17 w.	44
North Pacific Coast Region.						
Fort Canby, Wash	12	19	12	33	s. 72 w.	22
Neah, Wash	3	9	10	45	s. 80 w.	36
Port Crescent, Wash.*	0	2	6	24	s. 84 w.	18
Seattle, Wash	11	33	17	14	s. 30 e.	26
Tacoma, Wash	14	26	3	36	s. 70 w.	35
Portland, Oreg	17	28	8	26	s. 81 w.	18
Roseburg, Oreg	29	13	20	20	n.	16
Middle Pacific Coast Region.						
Eureka, Cal	33	13	10	26	n. 39 w.	36
Mount Tamalpais, Cal	25	4	1	42	n. 63 w.	46
Red Bluff, Cal	24	19	21	20	n. 11 e.	5
Sacramento, Cal	13	35	13	20	s. 30 w.	14
San Francisco, Cal	1	15	1	51	s. 74 w.	52
South Pacific Coast Region.						
Fresno, Cal	39	2	2	42	n. 47 w.	54
Los Angeles, Cal	6	27	3	40	s. 60 w.	42
San Diego, Cal	13	19	7	37	s. 79 w.	31
San Luis Obispo, Cal	25	5	3	34	n. 57 w.	37
West Indies.						
Basseterre, St. Kitts Island	6	6	55	1	e.	54
Bridgetown, Barbados	3	9	57	0	s. 85 e.	56
Cienfuegos, Cuba	39	7	28	3	n. 38 e.	47
Colon, U. S. of Colombia ‡	27	4	16	5	n. 26 e.	26
Havana, Cuba	26	1	49	0	n. 61 e.	56
Kingston, Jamaica	48	2	15	6	n. 11 e.	46
Port of Spain, Trinidad	2	5	57	1	s. 88 e.	56
San Juan, Porto Rico	2	31	42	5	s. 52 e.	47
Santiago de Cuba, Cuba	37	8	22	7	n. 20 e.	33
Willemstad, Curaçao	3	2	58	0	n. 90 e.	58

* From observations at 8 p. m. only † From observations at 8 a. m. only. ‡ For 20 days. § For 28½ days.

TABLE VII.—*Thunderstorms and auroras, May, 1899.*

States.	No. of stations.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total. No.	Total. Days.	
Alabama	53	T.				3		1	3			2		5	1					1			1	1	7					3	3	2		33	13	T.
		A.																																0	0	A.
Arizona	53	T.						1	2	1																								4	3	T.
		A.																																0	0	A.
Arkansas	57	T.		2	7	5	3	8	9	2	6	13	11	11	1				7	13	1	2	5	13	6			1		11	12	11	3	163	25	T.
		A.																																0	0	A.
California	189	T.		1		1	5	3		2						3				2					1	5				1	1			25	11	T.
		A.																																0	0	A.
Colorado	73	T.	1	4	1		6	13	3	4	1			3				5		4	12	5		1	2	1	11	1	3					81	19	T.
		A.																																0	0	A.
Connecticut	22	T.	8	7					1									1						1	1					10	6	1		36	9	T.
		A.															3																	3	1	A.
Delaware	5	T.		1														4	4												1	2		12	5	T.
		A.																																0	0	A.
Dist. of Columbia	4	T.		1						1	1							1	1	1											1		1	8	8	T.
		A.																																0	0	A.
Florida	45	T.				1		3			2	2		2	4	2	1	1		3	7	5	3		4	8	2	1			1	1	5	58	20	T.
		A.																																0	0	A.
Georgia	54	T.				6	3	3	2	6			3	1	5			1		7		1	5	4	4	1				3	2	9	7	73	19	T.
		A.																																0	0	A.
Idaho	27	T.					2	8	3	3												1	1	1	2	5	1			1	4			32	12	T.
		A.	2		1							1																						4	3	A.
Illinois	92	T.	9	21	26	9	1	8	22	7	1	27	4	5	1	26	11	10	27			5	16	6	1		3	19	24	29	25	13	26	382	28	T.
		A.	1		1	1																												3	3	A.
Indiana	55	T.	8	3	4	10		1	8	6		11	4	14	1	5	6	3	13	1		1	7					3	8	10	20	9	19	175	24	T.
		A.											1																					1	1	A.
Indian Territory	8	T.	1	2	4		4	4	4		1	5	2	1							1		2		4	1			1	5	3	4	1	50	19	T.
		A.																																0	0	A.
Iowa	126	T.	1	11	7				13	4	9	12			2	23	21	14	13		3	7	12	2		1	13	18	35	24	8	23	13	289	24	T.
		A.	1		5								1																					7	3	A.
Kansas	74	T.	4	19	9		4	5	12	4	22	14	1		5	2		3	12	10	22	21	6	14	9	3	12	9	7	6	7	8	9	259	28	T.
		A.																																0	0	A.
Kentucky	45	T.			1	10		9	10	11	1	9	2	14	1				3	4		1	9	7		1				3	11	12	14	133	20	T.
		A.																																0	0	A.
Louisiana	45	T.		1					1			2	1	4	5	3					1			5	7	1				1	1			33	13	T.
		A.																																0	0	A.
Maine	17	T.	4	9																								1				3		17	4	T.
		A.			2	1											1																	4	3	A.
Maryland	39	T.	5	21	5	2	2	2		19	11		3		1			30	25	14	1								1		26	6	20	194	18	T.
		A.																																0	0	A.
Massachusetts	54	T.	18	8										1												1				2	8			38	6	T.
		A.			4												2	1																7	3	A.
Michigan	107	T.	20	9	19	12						15	6	6	2		5	35	21								2	12	37	30	29	8	22	285	18	T.
		A.	2	1		1	2						1																					7	5	A.
Minnesota	64	T.	4	2	12			1		4	4	4				2	22	11			1	1	5	3	1	4	6	14	16	14	3	17	7	158	23	T.
		A.			7						1		1							1														10	4	A.
Mississippi	42	T.				2			4	2		5	2	9	3	2			1	3				4	10	1				2	6	5	2	63	17	T.
		A.																																0	0	A.
Missouri	89	T.	6	11	13	4	5	8	20		17	22	4	5		3	1	1	20	3	15	19	23	5	4	1	1	10	12	30	13	21	25	322	29	T.
		A.																																0	0	A.
Montana	37	T.						4	6									1	2		3					6	5	2	1	1	2			33	11	T.
		A.	1	1		2	1										1																	6	5	A.
Nebraska	145	T.		20	2		2	4	12	1	13	9			1	15	9	6	13	11	22	13	6	2	8	9	15	20	18	16	3	8	1	259	27	T.
		A.	1		2																													3	2	A.
Nevada	45	T.					1	1	1																	1					2			6	5	T.
		A.																																0	0	A.
New Hampshire	20	T.	10	7	2																										3	1		23	5	T.
		A.			2	1	1						1	1			2																	8	6	A.
New Jersey	50	T.		22									3					24	7					1	5					10	11	2	1	86	10	T.
		A.			1																													1	1	A.
New Mexico	38	T.				2	1	1		4		1							1						1		1							12	8	T.
		A.																																0	0	A.
New York	103	T.	39	24						1	1		2		1			13	4	5		1		2	1			2	3	27	37	4	2	169	18	T.
		A.				4	1										2																	7	3	A.
North Carolina	56	T.		2	11	8	1	8	17	13	1	5	6	11	16			2	2	9			1	9	1						15	1	11	150	21	T.
		A.																														1		1	1	A.
North Dakota	40	T.		6	2			2		3			1												3		4	6	1	2	1	10		41	12	T.
		A.				3	1																											4	2	A.
Ohio	124	T.	24	22	10	32	2		6	9	1	2	5	17			2	32	38	9									31	35	42	12	46	377	20	T.
		A.			2																	1											1	4	3	A.
Oklahoma	22	T.	6	4	4		5	8	1		6	5	6					3		2	2	3		1	3	2	1	2	1	2	5		3	75	22	T.
		A.																																0	0	A.
Oregon	71	T.					1	1							1	2			1			1		2	7	2	1	1			2	1	3	26	14	T.
		A.	2		1												1																	4	3	A.
Pennsylvania	100	T.	20	28	5					6	4			1	4			36	31	6					1				3	5	35	7	6	198	16	T.
		A.			2																													2	1	A.
Rhode Island	8	T.	1																											5				6	2	T.
		A.																																0	0	A.
South Carolina	44	T.			1	3	4	9	5	3		4	3	1	5					7			6	16	1						4	8	8	88	17	T.
		A.																																0	0	A.
South Dakota	52	T.	1	6	4		1	2	2		3	2	1		2	6	4	3			2	10	12	1	1	3	8	6	8	7	1	8		104	25	T.
		A.	2		3	2	1																											8	4	A.
Tennessee	61	T.			1	19	5	14	13	7	2	16	11	16	2				2	10		2	12	10	1					3	17	15	7	185	21	T.
		A.																																0	0	A.
Texas	83	T.	1	3	6	3	3	2	5	4	2	5	12	6					4	3	1		2	5	7		1	1		2	1	2		81	23	T.
		A.																																0	0	A.
Utah	34	T.	1	1					6	2	1					1					2						1		1		2		1	19	11	T.
		A.																																0	0	A.
Vermont	14	T.	10	5																														15	2	T.
		A.		1	3	1										1	1																	7	5	A.
Virginia	47	T.	1	5	14	3		1	3	13		1	2		9			7	5	6	2			3							24	3	17	119	18	T.
		A.																																0	0	A.
Washington	55	T.	1							1					2	1					1			3	5	3			1	1			1	20	11	T.
		A.	4		5	1	1																											11	4	A.
West Virginia	88	T.	4	3	5	5	2		2	6	1	1	1	5	3	1	1	4	7	7			1			1					9	5	14	88	22	T.
		A.																																0	0	A.
Wisconsin	60	T.	1	7	18	2			1	1	5	13		8			14	16	1							2	14	9	20	10	3	7	14	166	20	T.
		A.	2		1	3	1	1																										8	5	A.
Wyoming	18	T.				1		2	3	1							1	4			8	3	1			1	6	2	2		1			36	14	T.
		A.				1																												1	1	A.
Sums	2,804	T.	209	298	193	143	63	137	200	151	116	207	96	146	78	97	98	271	265	141	107	102	136	122	108	64	108	140	234	311	411	244	309	5,305	...	T.
		A.	18	3	42	21	9	1	0	0	1	1	5	1	0	1	13	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	121	....	A.

TABLE VIII.—*Average hourly sunshine (in percentages), May, 1899.*

Stations.	Instrument.	A. M. 5	6	7	8	9	10	11	Noon	P. M. 1	2	3	4	5	6	7	8	Hours of sunshine. Total. Actual.	Possible.	Percent of possible.	Personal estimate.
																		Hours.	*Hours.*		
Albany, N. Y	T.	29	29	46	74	76	77	79	75	77	75	74	72	53	38	35	26	278.2	454.9	61	50
Atlanta, Ga	T.	45	40	43	68	82	88	90	91	95	95	97	84	73	56	41	7	322.8	432.6	75	19
Atlantic City, N. J	P.	74	68	66	69	70	69	71	65	61	63	60	68	61	57	40	50	282.0	443.8	64	49
Baltimore, Md	T.	3	3	6	35	58	65	67	56	65	66	62	46	31	12	7	8	180.6	443.8	41	45
Binghamton, N. Y	T.	31	35	48	59	62	73	73	76	77	74	69	73	62	41	33	24	269.6	451.9	60	40
Bismarck, N. Dak	P.	23	25	32	32	39	43	50	44	46	54	50	47	43	46	29	25	188.2	467.4	40	43
Boise, Idaho	P.	22	29	50	67	71	78	77	73	53	51	58	73	61	46	30	26	258.4	457.9	56	40
Boston, Mass	T.	46	50	59	63	73	81	85	85	79	80	73	61	52	44	35	21	291.7	451.9	65	51
Buffalo, N. Y	T.	25	32	55	57	65	76	85	82	86	73	73	68	64	52	37	21	285.4	454.9	63	37
Charleston, S. C	T.	47	51	55	50	56	66	66	81	80	78	81	70	56	41	37	0	267.6	430.7	62	59
Chattanooga, Tenn	T.	56	44	43	42	56	66	76	81	80	71	72	68	63	49	40	50	264.1	434.2	61	49
Cheyenne, Wyo	P.	26	49	64	75	77	82	86	75	75	75	65	51	55	50	30	3	284.3	449.1	63	37
Chicago, Ill	T.	44	43	48	46	68	71	77	85	85	78	75	65	49	29	22	21	273.4	451.9	61	49
Cincinnati, Ohio	T.	36	32	33	40	64	53	79	76	73	71	57	67	66	50	40	50	264.9	443.8	60	45
Cleveland, Ohio	T.	48	42	41	40	43	45	55	57	60	63	63	49	44	36	32	29	214.4	451.9	47	43
Columbia, Mo	T.	45	46	46	59	73	81	85	90	89	81	75	73	72	64	54	31	309.6	443.8	70	34
Columbus, Ohio	T.	49	50	53	53	60	71	78	80	53	70	68	59	53	39	26	19	264.5	446.7	59	45
Denver, Colo	P.	81	82	90	94	92	90	88	87	82	75	73	73	67	71	53	40	354.1	446.7	79	59
Des Moines, Iowa	T.	20	26	25	35	39	42	52	51	51	56	55	53	51	42	42	38	196.6	451.9	44	37
Detroit, Mich	T.	42	39	45	61	71	75	77	85	83	80	72	62	58	45	28	25	279.9	451.9	62	40
Dodge, Kans	P.	71	64	69	82	88	88	88	85	84	83	83	83	79	66	56	46	345.2	441.7	78	59
Dubuque, Iowa	T.	44	48	46	45	56	69	75	74	76	73	60	59	41	31	29	28	249.2	451.9	55	47
Eastport, Me	P.	42	43	51	55	55	55	58	61	61	65	63	55	58	48	39	36	248.2	460.7	54	38
Elkins, W. Va	T.	16	10	15	42	61	69	70	71	76	72	64	50	42	18	7	8	207.9	443.8	47	30
Erie, Pa	T.	44	39	35	51	62	63	66	65	65	63	62	65	46	48	48	40	248.8	451.9	55	38
Escanaba, Mich	T.	47	48	48	51	61	66	66	71	65	63	57	53	45	21	16	15	236.7	464.1	51	49
Eureka, Cal	P.	18	18	28	36	41	45	58	61	56	65	68	62	56	44	36	34	212.9	449.1	47	42
Fresno, Cal	T.	61	69	85	95	99	98	97	97	97	97	98	97	95	91	83	70	405.0	439.0	92	84
Galveston, Tex	P.	......	0	26	66	77	81	80	86	88	88	81	74	75	54	10	.....	274.2	421.8	65	39
Grand Junction, Colo	P.	70	71	78	88	79	80	78	70	79	82	73	72	75	76	79	83	342.1	443.8	77	53
Harrisburg, Pa	T.	65	58	56	59	77	74	82	86	86	82	81	72	59	39	33	46	300.5	446.7	67	38
Helena, Mont	P.	26	34	44	55	56	52	50	51	56	58	50	49	52	41	39	37	223.5	467.4	48	36
Huron, S. Dak	T.	25	26	25	28	41	53	61	63	60	67	56	50	37	35	35	35	204.7	457.9	45	42
Idaho Falls, Idaho	T.	13	19	26	50	56	66	64	66	61	53	49	40	38	25	19	17	199.5	454.9	44	35
Indianapolis, Ind	T.	45	45	43	43	45	49	57	53	54	55	47	42	33	29	29	38	198.6	446.7	44	35
Jacksonville, Fla	T.	100	85	54	69	86	87	91	87	88	87	84	79	76	39	26	......	308.6	423.7	73	59
Kansas City, Mo	P.	23	28	40	55	60	60	57	51	51	69	69	73	68	59	50	58	248.8	443.8	56	42
Key West, Fla	T.	......	41	51	77	87	97	97	91	86	91	88	85	84	69	53	......	330.6	414.6	80	65
Knoxville, Tenn	T.	14	14	16	39	64	74	80	82	89	69	68	72	53	29	11	0	235.9	436.7	54	44
Lexington, Ky	T.	26	23	40	58	67	75	74	77	88	82	75	74	71	56	40	47	281.7	441.7	64	45
Little Rock, Ark	T.	33	29	37	50	65	66	74	69	80	80	71	67	49	39	33	50	251.1	434.2	58	44
Los Angeles, Cal	P.	18	35	37	35	45	58	72	76	79	82	81	86	91	86	80	75	287.4	432.6	66	56
Louisville, Ky	T.	60	45	40	43	55	68	70	65	69	66	64	59	55	35	30	39	240.9	441.7	55	39
Macon, Ga	T.	53	47	71	85	87	92	91	92	94	92	98	91	87	69	53	40	354.2	430.7	82	62
Meridian, Miss	T.	25	45	47	73	84	96	98	96	95	94	95	90	83	58	51	0	338.5	428.4	79	64
Minneapolis, Minn	T.	22	26	27	37	43	50	47	58	56	60	57	53	42	23	19	21	191.0	460.7	41	......
Mount Tamalpais, Cal	P.	47	45	82	81	83	81	79	72	74	85	88	88	92	90	64	11	344.6	441.7	78	59
Nashville, Tenn	T.	19	16	19	40	58	58	68	81	93	86	85	66	54	32	18	0	240.5	436.7	55	43
New Orleans, La	T.	80	59	57	67	72	85	82	85	87	87	82	76	74	60	64	......	315.6	423.7	74	65
New York, N. Y	T.	33	29	35	49	65	76	81	80	79	75	69	66	53	44	29	38	262.7	449.1	58	48
Northfield, Vt	P.	38	44	56	60	57	58	62	56	57	58	53	46	56	50	29	24	237.8	457.9	52	40
Oklahoma, Okla	T.	63	44	52	64	74	79	80	81	77	82	71	81	75	56	49	62	302.6	434.2	70	60
Omaha, Nebr	P.	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Parkersburg, W. Va	T.	19	13	18	32	42	54	63	66	63	54	49	37	21	7	7	11	164.8	443.8	37	36
Phenix, Ariz	P.	93	83	91	95	95	97	96	96	96	94	92	88	91	84	78	60	393.5	430.7	91	80
Philadelphia, Pa	T.	51	55	58	63	77	81	87	86	83	83	80	77	70	58	42	44	316.0	446.7	71	44
Pittsburg, Pa	T.	45	35	35	36	48	54	56	56	56	46	41	38	23	18	14	21	178.1	449.1	40	47
Portland, Me	T.	16	36	60	77	80	82	81	84	83	80	79	75	63	46	28	14	299.4	457.9	65	48
Portland, Oreg	T.	0	0	3	8	20	29	32	43	47	46	42	36	30	15	7	5	112.2	464.1	24	23
Raleigh, N. C	T.	53	39	39	49	59	72	74	80	79	73	71	64	53	43	34	50	258.6	436.7	59	55
Rochester, N. Y	T.	35	36	45	55	54	63	67	74	80	78	70	63	57	48	25	15	258.0	454.9	57	53
St. Louis, Mo	T.	38	35	46	66	75	75	79	82	83	90	81	76	66	56	45	58	300.9	443.8	68	31
St. Paul, Minn	P.	41	42	43	49	52	48	49	55	56	56	62	60	63	51	39	41	235.6	460.7	51	42
Salt Lake City, Utah	P.	42	49	56	56	72	78	73	73	62	63	63	67	58	35	32	28	265.3	449.1	59	42
San Diego, Cal	P.	20	28	28	31	47	66	74	82	87	90	89	86	76	56	51	0	274.8	430.7	64	58
San Francisco, Cal	T.	55	58	59	71	82	85	96	97	97	96	97	96	88	74	68	64	365.1	441.7	83	74
Santa Fe, N. Mex	P.	75	78	88	88	90	89	98	86	90	91	87	79	83	77	72	93	371.3	436.7	85	72
Savannah, Ga	T.	50	65	63	75	83	95	96	95	95	89	91	82	65	45	49	0	334.7	428.4	78	64
Seattle, Wash	T.	4	3	6	9	13	24	47	55	61	54	49	41	21	13	0	0	123.3	471.3	26	28
Spokane, Wash	T.	32	35	46	65	68	67	71	76	81	74	70	61	58	44	18	6	266.1	471.3	56	36
Tacoma, Wash	T.	15	8	14	23	35	58	74	72	74	76	64	55	52	33	16	7	206.0	467.4	44	24
Tampa, Fla.*	T.	......	73	67	62	70	78	89	85	86	82	82	77	62	53	52	......	207.1	282.5	73	61
Topeka, Kans	T.	45	42	45	48	57	67	81	82	84	85	86	78	72	51	42	36	289.7	443.8	65	46
Vicksburg, Miss	T.	6	23	23	49	69	89	94	95	90	89	83	76	65	45	26	100	285.6	428.4	67	62
Washington, D. C	P.	61	52	53	60	62	67	67	67	67	74	72	70	61	54	49	50	276.4	443.8	62	55
Wilmington, N. C	T.	27	29	28	58	63	70	77	85	83	83	77	72	65	48	35	50	269.7	432.6	62	55
Yankton, S. Dak	T.	23	24	32	49	51	59	63	66	69	64	63	54	42	35	17	14	217.3	454.9	48	35
Basseterre, St. Kitts	T.	......	25	30	44	64	75	84	84	86	80	67	56	35	12	11	......	228.0	401.0	57	42
Bridgetown, Barbados	T.	......	49	61	69	77	81	79	78	70	72	71	67	55	47	33	......	266.7	394.8	68	38
Cienfuegos, Cuba	T.	......	91	94	90	87	92	92	94	93	92	83	67	49	39	36	......	326.0	409.4	80	78
Colon, United States of Columbia †	T.	......	30	32	64	82	83	84	80	86	77	64	50	27	10	10	......	150.1	250.6	60	36
Havana, Cuba	T.	......	64	65	64	72	90	80	99	96	91	85	85	63	61	63	......	322.0	411.3	78	72
Kingston, Jamaica, W. I	T.	......	66	69	83	95	95	94	89	86	71	51	45	32	22	29	......	273.0	402.7	68	43
Port of Spain, Trinidad, W. I	T.	......	70	74	88	96	99	100	100	100	99	96	96	89	73	66	......	357.6	392.0	91	56
San Juan, Porto Rico	T	......	49	69	90	92	92	94	91	84	75	65	56	46	39	11	......	287.1	402.7	71	55
Santiago de Cuba, Cuba	T.	......	89	90	84	89	82	71	78	90	88	71	50	30	20	14	......	280.5	406.3	69	57
Santo Domingo, Santo Domingo	T.	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Willemstad, Curaçao	T.	......	33	52	90	97	100	100	100	100	100	100	96	87	56	20	......	340.3	393.6	86	55

* All values for 21 days only. † All values for 20 days only.

TABLE IX.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.75 in 1 hour during May, 1899, at all stations furnished with self-registering gauges.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total am't of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y.	1			0.55										0.51							
Atlanta, Ga.	30			0.44														0.33			
Atlantic City, N. J.	11			0.72														*			
Baltimore, Md.	16	6.50 p.m.	8.20 p.m.	0.74	7.08 p.m.	7.26 p.m.	T.	0.23	0.42	0.51	0.53										
Binghamton, N. Y.	2			0.49										0.44							
Bismarck, N. Dak.	2	9.30 a.m.	D. N.	1.64	7.23 p.m.	7.55 p.m.	0.10	0.10	0.20	0.29	0.40	0.52	0.60	0.66	0.69	0.72	0.75	0.82	0.94		
	26	D. N.	D. N.	1.18	12.18 a.m.	1.00 a.m.	T.	0.20	0.33	0.45	0.63	0.76	0.92	0.97	1.02	1.05					
Boise, Idaho	6-7			0.51														0.42			
Boston, Mass.	1-2			0.36														0.30			
Buffalo, N. Y.	29	3.45 p.m.	8.45 p.m.	1.44	3.48 p.m.	4.30 p.m.	T.	0.04	0.26	0.40	0.43	0.62	0.90	1.10	1.33	1.35					
Cairo, Ill.	7	D. N.	8.20 a.m.	1.07	6.43 a.m.	7.20 a.m.	0.38	0.16	0.31	0.39	0.42	0.45	0.49	0.65	0.68						
Charleston, S. C.	11	2.44 a.m.	4.25 a.m.	1.57	3.00 a.m.	3.50 a.m.	0.02	0.05	0.13	0.25	0.40	0.58	0.78	0.93	1.10	1.31	1.53	1.55			
	22	7.12 p.m.	11.38 p.m.	1.22	7.32 p.m.	7.50 p.m.	0.01	0.18	0.40	0.68	0.73										
Cincinnati, Ohio	29	9.50 a.m.	1.45 p.m.	1.12	10.02 a.m.	10.35 a.m.	T.	0.08	0.31	0.77	0.83	0.88	0.99	1.06							
Cleveland, Ohio	17			0.49													0.49				
Columbia, Mo.	31	5.25 a.m.	9.20 a.m.	1.07	5.28 a.m.	6.08 a.m.	0.01	0.07	0.22	0.36	0.49	0.66	0.81	0.89	0.94	0.95					
Columbus, Ohio	7			0.65														0.55			
Denver, Colo.	2			0.05														0.03			
Des Moines, Iowa	14			1.00														*			
Detroit, Mich.	16	1.13 p.m.	3.10 p.m.	0.85	1.15 p.m.	1.30 p.m.	T.	0.35	0.70	0.75											
Dodge, Kans.	9	7.40 p.m.	9.55 p.m.	0.47	7.47 p.m.	7.55 p.m.	T.	0.30	0.40												
Duluth, Minn.	30-31	9.30 p.m.	3.00 a.m.	1.14	1.14 a.m.	1.44 a.m.	0.55	0.05	0.14	0.30	0.43	0.47	0.50								
Eastport, Me.	20-21			1.84														0.15			
Elkins, W. Va.	11			1.10														0.50			
Erie, Pa.	27-28			1.34														0.50			
Escanaba, Mich.	10			0.35												0.35					
Fort Worth, Tex.	7			0.64														0.48			
Fresno, Cal.	†			0.52														0.17			
Galveston, Tex.	23			T.														T.			
Grand Junction, Colo.	2			0.08														0.02			
Hannibal, Mo.	28-29			1.91														0.69			
Harrisburg, Pa.	29			0.74														0.55			
Hatteras, N. C.	18			0.34														0.30			
Huron, S. Dak.	2	7.45 p.m.	11.55 p.m.	1.01	11.10 p.m.	11.20 p.m.	0.57	0.27	0.35	0.37	0.39										
Idaho Falls, Idaho	20-21			1.09														0.15			
Indianapolis, Ind.	7			0.60														0.41			
Jacksonville, Fla.	13	7.25 p.m.	8.30 p.m.	0.61	7.25 p.m.	7.50 p.m.	0.00	0.04	0.21	0.40	0.48	0.56	0.58	0.60							
Jupiter, Fla.	24	7.00 p.m.	7.30 p.m.	0.64	7.05 p.m.	7.25 p.m.	T.	0.10	0.25	0.52	0.64										
Kansas City, Mo.	10	2.30 a.m.	3.45 a.m.	0.94	2.32 a.m.	3.00 a.m.	T.	0.23	0.35	0.50	0.65	0.82	0.88	0.90	0.91	0.92					
	19-20	7.50 p.m.	6.50 a.m.	1.62	8.08 p.m.	8.20 p.m.	0.04	0.31	0.50	0.53											
	31	3.07 a.m.	5.45 a.m.	1.29	3.10 a.m.	3.45 a.m.	T.	0.08	0.15	0.20	0.30	0.49	0.71	0.80							
Key West, Fla.	26			0.31										0.31							
Knoxville, Tenn.	4			0.80														0.36			
Lexington, Ky.	12	10.11 a.m.	12.43 p.m.	1.09	11.52 a.m.	12.15 p.m.	C.45	0.06	0.14	0.38	0.52	0.60									
Lincoln, Nebr.	2			0.41														0.38			
Little Rock, Ark.	28-29	8.15 p.m.	D. N.	1.76	10.50 p.m.	11.10 p.m.	0.23	0.45	0.55	0.62											
Los Angeles, Cal.	6			0.04														0.04			
Louisville, Ky.	29			0.44														0.40			
Macon	18			0.43								0.39									
Memphis, Tenn.	4	10.56 a.m.	11.50 a.m.	0.94	10.56 a.m.	11.07 a.m.	0.00	0.45	0.79	0.91	0.92	0.93	0.94								
Meridian, Miss.	12-13	6.50 p.m.	D. N.	2.24	7.08 p.m.	8.10 p.m.	0.18	0.31	0.58	0.61	0.72	0.77	0.77	0.77	0.77	0.80	0.98	1.12	1.15	1.19	1.20
Milwaukee, Wis.	27			0.54														0.45			
Montgomery, Ala.	23	3.53 p.m.	7.25 p.m.	0.80	4.17 p.m.	4.40 p.m.	T.	0.20	0.36	0.53	0.64	0.68									
Nantucket, Mass.	17			0.20														0.09			
Nashville, Tenn.	6			0.95					0.35												
New Orleans, La.	29			0.14												0.14					
New York, N. Y.	11			0.54														0.24			
Norfolk, Va.	8			0.32								0.24									
Northfield, Vt.	2			0.27														0.27			
Oklahoma, Okla.	3	12.20 a.m.	1.20 a.m.	0.81	12.50 a.m.	1.05 a.m.	0.06	0.12	0.34	0.67	0.72	0.73									
	5	5.35 a.m.	4.45 p.m.	4.24	6.25 a.m.	8.30 a.m.	0.06	0.12	0.37	0.54	0.72	1.04	1.33	1.54	1.57	1.58	1.61	1.67	1.79	2.44	2.85
	6	4.15 p.m.	11.35 p.m.	2.63	4.25 p.m.	4.45 p.m.	0.04	0.20	0.54	0.86	0.96										
					5.40 p.m.	6.05 p.m.	1.19	0.15	0.56	0.83	0.91	1.05									
Omaha, Nebr.	7			1.11														0.27			
Parkersburg, W. Va.	31	3.05 p.m.	7.15 p.m.	0.80	3.12 p.m.	3.37 p.m.	0.01	0.32	0.65	0.73	0.75	0.76									
Philadelphia, Pa.	11			0.79														0.28			
Pittsburg, Pa.	16-17			0.98														*			
Portland, Me.	20-21			0.33														0.04			
Portland, Oreg.	10-11			0.52														0.15			
Raleigh, N. C.	7	5.40 p.m.	8.20 p.m.	1.13	6.10 p.m.	6.30 p.m.	0.06	0.17	0.45	0.73	0.92	0.96	1.00								
Richmond, Va.	29-30			0.72														0.38			
Rochester, N. Y.	29			0.71														0.51			
St. Louis, Mo.	7	5.31 p.m.	5.43 p.m.	0.42	5.33 p.m.	5.43 p.m.	T.	0.25	0.42												
	10	5.28 p.m.	9.20 p.m.	0.69	5.45 p.m.	6.00 p.m.	T.	0.15	0.36	0.47	0.48										
	21	6.18 p.m.	9.35 p.m.	0.75	7.50 p.m.	8.18 p.m.	0.03	0.05	0.22	0.33	0.44	0.62	0.69								
St. Paul, Minn.	28	7.15 p.m.	8.15 p.m.	0.58	7.47 p.m.	8.02 p.m.	0.05	0.25	0.51	0.53											
Salt Lake City, Utah	27			0.72														0.28			
San Diego, Cal.	1			0.07														0.07			
San Francisco, Cal.	31			0.77														0.18			
Savannah, Ga.	13			0.41											0.40						
Seattle, Wash.	10-11			0.53														0.13			
Spokane, Wash.	8			0.23														0.08			
Tampa, Fla.	6			0.34														0.34			
Topeka	20	10.35 p.m.	11.50 p.m.	1.03	11.10 p.m.	11.27 p.m.	0.21	0.20	0.55	0.75	0.82										
Vicksburg, Miss.	29	7.40 a.m.	9.45 a.m.	0.78	8.00 a.m.	8.20 a.m.	T.	0.17	0.54	0.71	0.76										
Washington, D. C.	8	4.02 p.m.	5.20 p.m.	0.41	4.02 p.m.	4.10 p.m.	0.00	0.28	0.36	0.37											
	31	7.41 p.m.	10.30 p.m.	0.76	8.10 p.m.	8.40 p.m.	T.	0.04	0.23	0.46	0.54	0.59	0.63	0.66							
Wilmington, N. C.	7-8	8.30 p.m.	2.00 a.m.	1.00	8.30 p.m.	9.00 p.m.	0.00	0.09	0.29	0.42	0.51	0.58	0.69	0.73	0.74	0.76	0.77	0.79			
	22	5.10 p.m.	5.50 p.m.	0.47	5.20 p.m.	5.35 p.m.	T.	0.14	0.40	0.46	0.47										
Yankton, S. Dak.	20-21			0.78														0.47			
Basseterre, St. Kitts	28			0.17											0.17						
Bridgetown, Barbados	17	6.45 a.m.	9.15 a.m.	0.63	7.34 a.m.	8.01 a.m.	0.10	0.20	0.30	0.32	0.36	0.45									
Cienfuegos, Cuba	29			0.20				0.18													
Colon, U. S. C.	16			0.61														0.52			
Havana, Cuba	25	2.58 p.m.	4.30 p.m.	1.24	2.59 p.m.	3.45 p.m.	0.01	0.15	0.24	0.44	0.64	0.82	0.93	1.04	1.10	1.15	1.18	1.20			
Kingston, Jamaica	7	2.30 p.m.	3.23 p.m.	1.19	2.34 p.m.	3.08 p.m.	T.	0.21	0.53	0.76	0.95	1.06	1.17	1.19							
	8	2.47 p.m.	4.53 p.m.	0.59	2.49 p.m.	3.05 p.m.	T.	0.19	0.37	0.52	0.53										
Port of Spain, Trin.	18			0.20						0.20											
Roseau, Dominica, W. I.	8			0.09														0.05			
San Juan, Porto Rico	15			0.36										0.36							
Santiago de Cuba	28	4.52 p.m.	6.40 p.m.	1.27	5.44 p.m.	6.15 p.m.	0.16	0.18	0.40	0.70	0.90	1.00	1.05	1.07							
Willemstad, Curaçao	1			0.07														0.06			

* Record incomplete on account of snow or other causes. † May 31 to June 1.

TABLE X.—*Excessive precipitation, by stations, for May, 1899.*

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Alabama.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Marion		4.00	23-24			
Tuscumbia				1.05	1 00	13
Wilson				1.95	0 45	23
Arkansas						
Amity	11.04	4.27	18			
Blanchard Springs				1.05	1 00	10
Camden		2.85	28-29			
Fayetteville		3.10	5-6			
Fort Smith		3.52	5-6			
Moore	13.36	5.50	11-12			
Mossville		3.41	5-6			
Mount Nebo		2.87	11-12			
Pinebluff		3.05	28-29			
Silver Springs		3.60	5-6			
Spielerville				1.60	1 30	28
Warren		2.92	28-29			
Washington		2.50	29			
California.						
Crescent City		2.53	31			
Fort Ross		3.67	31			
Thermalito				1.16	0 20	5
Florida.						
Macclenny		2.91	23			
Manatee				1.30	1 00	15
Georgia.						
Augusta				1.67	1 11	22
Mauzy		3.84	24			
Illinois.						
Beardstown	11.28	3.37	7			
Griggsville	13.10	2.60	26			
Do		5.33	28			
Hillsboro				1.90	0 55	10
La Harpe	12.57	4.40	21			
Lanark				1.08	1 00	3
Loami	10.51					
Rantoul				1.50	0 50	10
Savanna		2.50	28			
Springfield	11.81	2.54	26			
Indiana.						
Vevay				1.50	1 00	31
Indian Territory.						
Healdton				1.90	0 20	28
Lehigh		3.69	28	3.10	3 00	28
South McAlester		3.24	5-6			
Tulsa		5.37	5-6			
Iowa.						
Alta		4.85	27-28			
Baxter		4.45	14-15			
Bedford		2.50	20			
Belknap		2.90	20			
Belleplaine		2.90	28			
Carroll		2.70	27-28			
Clarinda		3.60	19-20			
Clear Lake	11.43					
Clinton		3.06	26-27			
College Springs		4.12	20			
Eldon		3.01	14			
Fonda		6.35	27			
Fort Madison	12.24	2.83	21			
Grinnell		2.85	14			
Grundy Center		2.97	27			
Hampton		2.81	27			
Humboldt		3.80	27-28			
Iowa City		4.10	14-15			
Keokuk	11.47	2.52	7			
Keosauqua		2.76	19-20			
Maple Valley		4.43	27			
Mooar	10.34					
Mount Vernon	11.20	3.40	27			
Murray		2.90	19-20			
Ogden		3.15	28			
Olin		2.74	28			
Osceola				1.20	0 30	7
Storm Lake		4.15	27	3.00	2 00	27
Thurman		2.89	19-20			
Waterloo				1.62	1 00	27
Westbranch		2.80	15			
Westunion		3.00	28			
Woodburn		3.00	19-20			
Kansas.						
Campbell		4.50	19-20			
Gove				2.30	1 30	25
Halstead				1.66	1 20	22
Horton		2.74	20			
Marion		3.00	22			
Norwich		4.16	19-20			
Paola				1.83	1 30	20-21
Seneca		3.26	20			
Topeka				1.01	0 36	20
Wallace				1.19	1 10	19
Kentucky.						
Alpha				1.02	0 40	31
Earlington		3.12	7	2.00	0 20	7
Greensburg		2.53	6-7			
Louisiana.						
Baton Rouge				1.57	1 00	23
Jennings		4.10	22			
Lake Providence		3.09	12			
Paincourtville				1.52	1 30	19
Plain Dealing		2.92	12			

TABLE X.—*Excessive precipitation*—Continued.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Maryland.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Bachmans Valley		3.25	29			
Grantsville		3.00	17			
Michigan.						
Arbela				1.71	1 00	28
Ewen		2.50	17			
Minnesota.						
Glenwood		3.48	30			
Lynd		2.51	2-3			
Minneapolis (Weather Bureau)				1.16	0 40	28
Do (voluntary observer)				1.91	0 50	28
Park Rapids		2.50	31			
Mississippi.						
Leakesville		2.96	23			
Macon				1.10	1 00	24
Meridian				1.15	1 01	12
Thornton		3.40	12			
Yazoo City				1.78	1 20	23
Missouri.						
Appleton City		2.50	10			
Bethany		2.70	19-20			
Birchtree		2.50	21-22			
Conception		4.01	19			
Galena		3.06	29-30			
Hazelhurst		3.00	19-20			
Irena		2.75	20			
Jackson		2.62	7			
Louisiana		2.50	20			
McCune		3.25	20			
Maryville		3.98	20			
Miami		3.35	20			
Pickering		3.34	20			
Springfield				1.57	0 51	10
Sublett	11.38	3.00	20			
Trenton		2.80	20			
Warrensburg		2.52	20			
Wylie		2.69	7			
Nebraska.						
Arborville		3.43	2			
Auburn		2.79	19			
Dawson		2.74	20			
Eden		4.30	20			
Genoa		2.70	1			
Grand Island		3.02	26-27			
Hartington		2.85	3			
Hebron		2.63	19			
Holdrege		4.00	20			
Madison		2.70	3			
Nebraska City		3.28	20			
Nemaha		3.68	19-20			
Nesbit				1.60	0 30	23
Norfolk		3.30	3			
Syracuse		2.60	21			
Tablerock		2.90	20			
Turlington		2.50	19			
Wallace				2.00	1 10	19
New York.						
Buffalo				1.34	0 40	29
North Carolina.						
Pantego				2.05	2 00	13
Raleigh				1.00	0 25	7
North Dakota.						
Bismarck				1.00	0 39	26
Towner		3.80	3			
Ohio.						
Ashtabula		2.50	28			
Cincinnati				1.01	0 30	29
New Waterford				1.50	1 50	29
Philo				1.07	0 10	17
Sylvania		2.78	15-16			
Toledo				1.15	0 45	16
Walnut				1.24	1 00	4
Oklahoma.						
Clifton		4.88	5	1.75	1 00	7
Norman		3.35	5			
Oklahoma		4.36	5-6	1.54	0 35	5
Do		2.81	6	1.00	0 32	5
Do				1.00	0 30	6
Do				1.02	0 21	6
Pawhuska	12.30	5.30	19			
Putnam				1.29	1 00	19
Oregon.						
Langlois		2.60	31			
Pennsylvania.						
Confluence		2.50	16-17			
South Carolina.						
Charleston				1.45	0 42	11
South Dakota.						
Aberdeen		3.35	30			
Centerville		2.78	2			
Farmingdale		2.70	20			
Hot Springs		3.00	19-20			
Rapid City		4.24	19-20			
Silver City		4.24	20			
Tennessee.						
Wildersville				1.12	1 00	4
Texas.						
Abilene				1.00	1 00	24
Arthur		2.80	28-29			
Beaumont				2.00	2 00	24
Beeville		2.50	10-11			

TABLE X.—*Excessive precipitation.*—Continued.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Texas—Continued.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Blanco		2.50	10-11			
Brighton		2.52	11			
Camp Eagle Pass		2.50	4			
Estelle				1.45	0 12	6
Fredericksburg				1.67	1 30	21
Honey Grove		3.00	22			
Houston		3.11	23			
Lampasas		2.70	10			
Longview		3.85	9-10			
Palestine		4.20	10-11			
Runge		2.85	11			
San Marcos		2.99	10-11			
Temple		2.80	10			
Victoria		3.00	11			
Waco		3.10	10			
Virginia.	*Inches.*	*Inches.*		*Ins.*	*h.m.*	
Callaville				1.18	1 00	18
Washington.						
Clearwater	10.87					
Wisconsin.						
Citypoint		2.50	3	2.50	1 00	3
Eau Claire		4.62	26-27			
Hartford				1.62	1 20	31
Neillsville				1.50	1 30	3
Prentice				1.06	0 40	16
West Indies.						
Havana				1.00	0 38	25
Kingston				1.19	0 35	7
Santiago de Cuba				1.00	0 25	28

TABLE XI.—*Data furnished by the Canadian Meteorological Service, May,* 1899.

Stations.	Pressure.			Temperature.				Precipitation.		
	Mean not reduced.	Mean reduced.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Depth of snow.
	Ins.	Ins.	Ins.	°	°	°	°	Ins.	Ins.	Ins.
St. Johns, N. F	29.75	29.90	—.06	40.6	— 2.3	47.8	33.4	3.75		0.5
Sydney, C. B. I	29.95	29.99	+.02	45.0	— 0.2	54.3	35.7	2.23	—2.10	1.0
Halifax, N. S	29.90	30.01	+.04	48.3	— 0.1	57.7	39.0	3.68	—1.04	0.2
Grand Manan, N. B	29.96	30.01	+.03	48.4	+ 0.5	56.0	40.8	4.38	+0.85	
Yarmouth, N. S	29.94	30.02	+.04	48.2	+ 0.6	56.3	40.2	1.96	—2.07	
Charlottet'n, P. E. I	29.96	30.00	+.04	47.9	— 1.0	57.3	38.5	2.25	—0.90	5.2
Chatham, N. B	29.99	30.01	+.06	49.7	+ 1.2	61.2	38.3	1.22	—1.68	1.5
Father Point, Que	29.98	30.00	+.05	44.4	+ 0.4	54.5	34.4	1.39	—1.04	
Quebec, Que	29.70	30.02	+.07	52.5	+ 2.6	62.6	42.4	2.41	—0.71	
Montreal, Que	29.79	29.99	+.06	56.6	+ 1.9	66.0	47.2	1.59	—1.49	
Bissett, Ont	29.41	30.02	+.08	54.0		68.1	39.9	3.17		
Ottawa, Ont	29.64	29.94		57.4	+ 2.5	68.6	46.1	5.50		
Kingston, Ont	29.70	30.01	+.05	53.6	+ 0.7	62.2	45.1	2.93	+0.18	
Toronto, Ont	29.65	30.03	+.05	56.0	+ 2.8	65.5	46.5	3.28	+0.63	
White River, Ont	28.69	30.04	+.06	47.7	+ 2.0	61.4	34.0	3.38	+1.87	0.4
Port Stanley, Ont	29.39	30.03	+.06	55.5	+ 2.4	63.9	47.1	4.47	+1.63	
Saugeen, Ont	29.31	30.02	+.06	53.4	+ 2.7	62.8	44.1	2.72	+0.15	
Parry Sound, Ont	29.32	30.01	+.05	53.6	+ 2.5	64.9	42.4	4.06	+0.74	
Port Arthur, Ont	29.28	29.98	+.05	46.6	+ 0.7	56.7	36.4	3.40	+1.22	
Winnipeg, Man	29.11	29.93	—.01	50.5	— 1.1	62.0	39.0	2.20	—0.62	T.
Minnedosa, Man	28.13	29.94	+.04	47.2	— 1.2	58.3	36.0	2.57	+0.93	0.8
Qu'Appelle, Assin	27.65	29.91	+.02	45.9	— 3.9	56.8	34.9	3.33	+1.81	20.3
Medicine Hat, Assin.	27.58	29.86	—.01	49.6	— 4.5	61.8	37.4	3.32	+2.16	8.0
Swift Current, Assin.	27.34	29.92	+.02	47.5	— 3.0	58.6	36.4	2.40	+0.91	8.0
Calgary, Alberta	26.31	29.85	—.04	44.4	— 5.4	57.7	31.2	5.44	+3.95	2.8
Banff, Alberta	25.27	29.93		40.3		51.7	28.9	4.02		21.4
Edmonton, Alberta	27.59	29.89	.00	47.0	— 3.8	59.6	34.4	2.28	+0.68	1.7
Prince Albert, Sask	28.36	29.90		47.0	— 0.6	59.6	34.5	1.97		9.5
Battleford, Sask	28.19	29.92		48.0	— 3.0	59.9	36.2	2.58		13.1
Kamloops, B. C	28.62	29.89		53.6		65.1	42.1	0.49		
Esquimalt, B. C	29.98	30.01		50.0	— 0.2	56.8	43.2	1.50		
Hamilton, Bermuda.	29.89	30.05	+.02	66.8	+ 2.6	72.2	61.5	4.15		

Chart I. Tracks of Centers of High Areas. May, 1899.

Chart I. Tracks of Centers of High Areas. May, 1899.

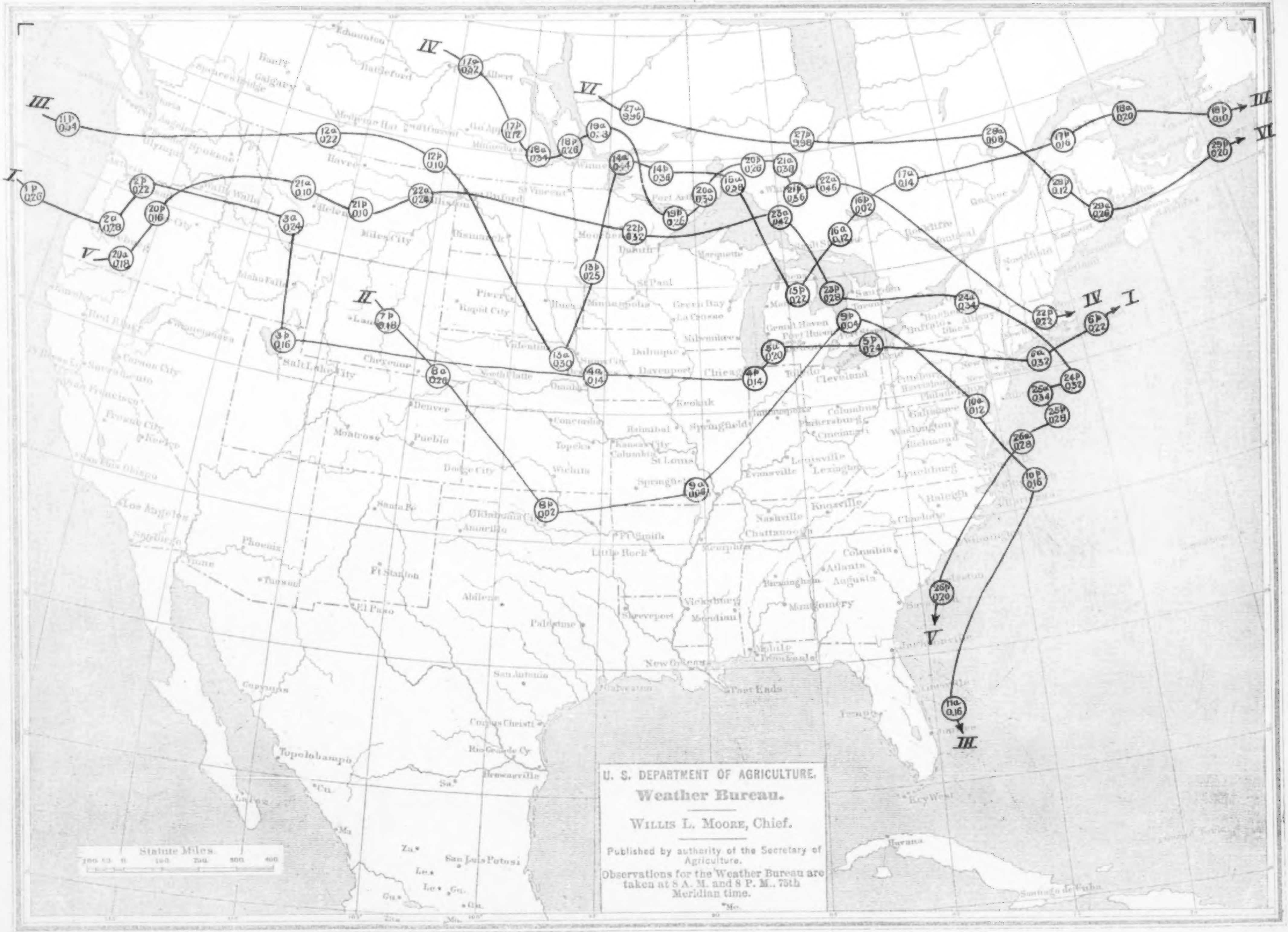


Chart II. Tracks of Centers of Low Areas. May, 1899.

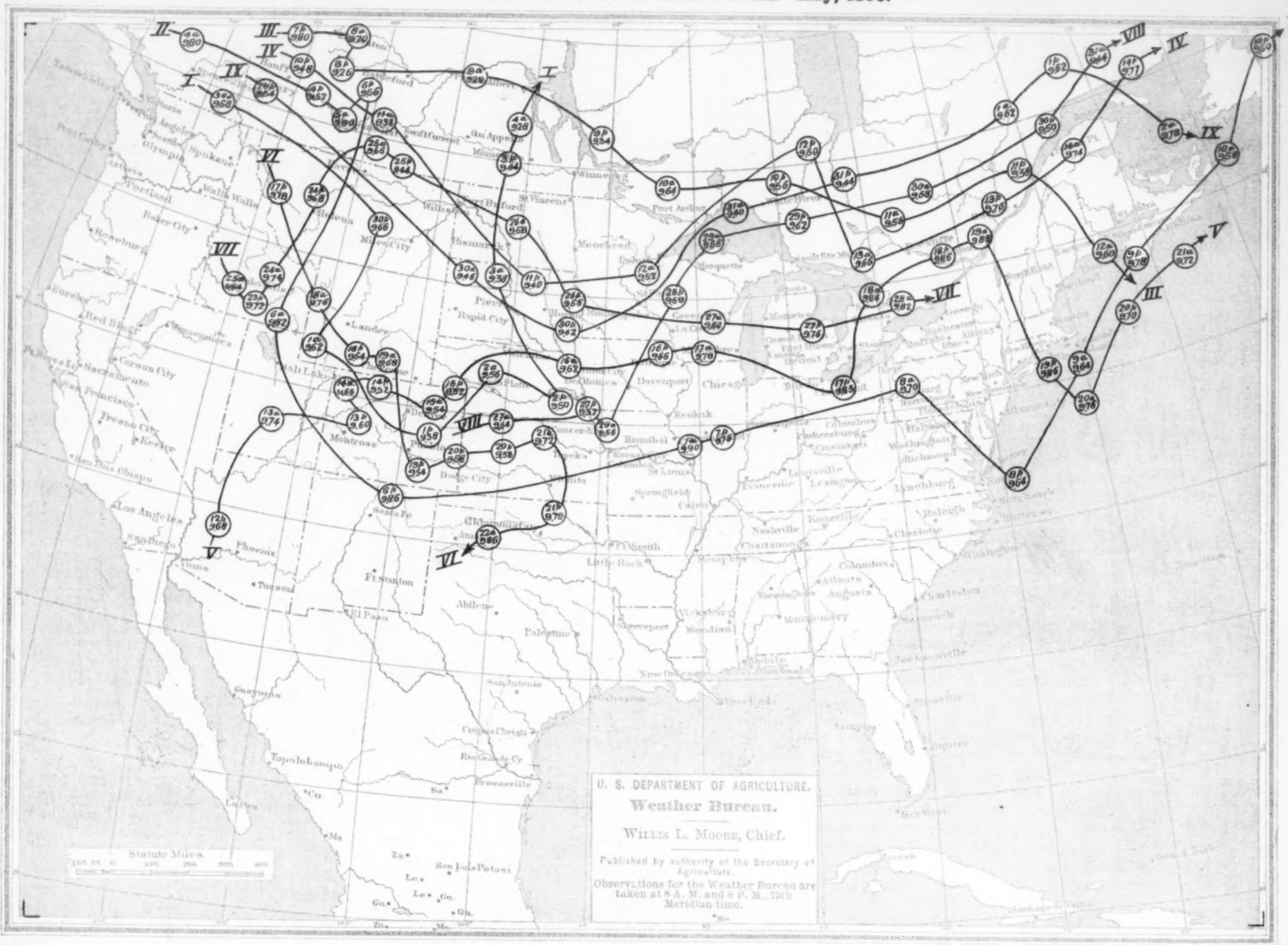


Chart III. Total Precipitation. May, 1899.

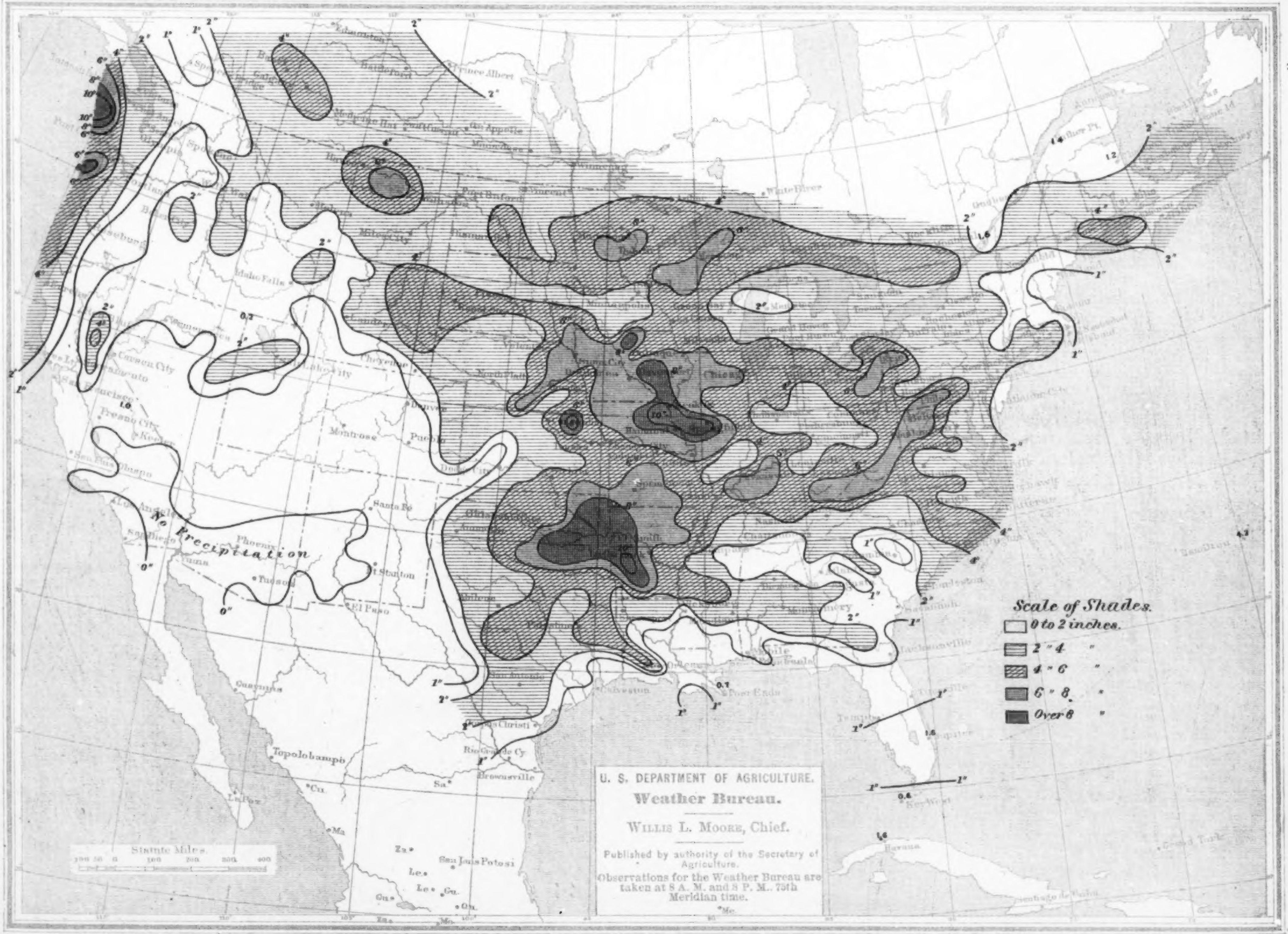
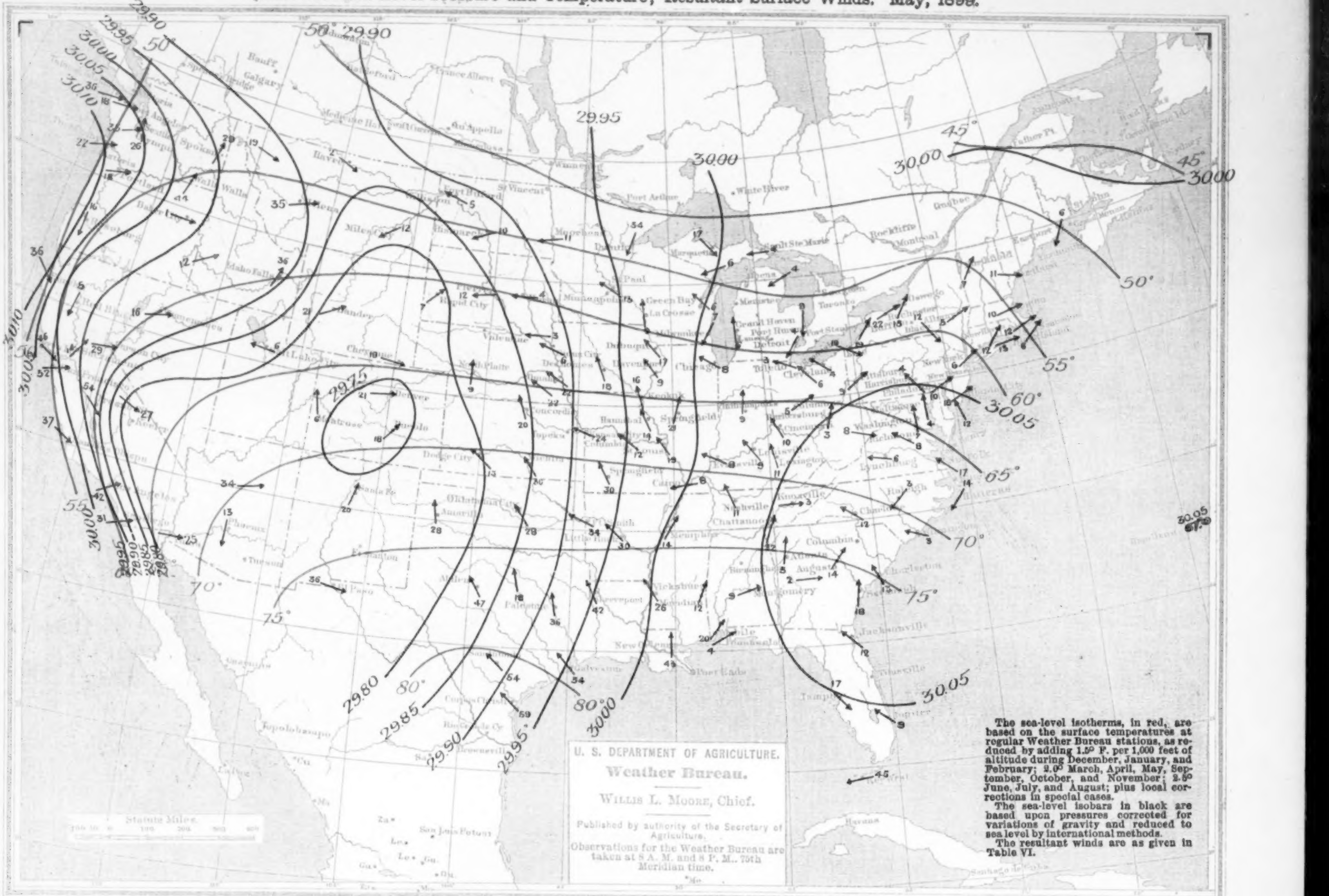


Chart IV. Sea-Level Pressure and Temperature; Resultant Surface Winds. May, 1899.



The sea-level isotherms, in red, are based on the surface temperatures at regular Weather Bureau stations, as reduced by adding 1.5° F. per 1,000 feet of altitude during December, January, and February; 2.0° March, April, May, September, October, and November; 2.5° June, July, and August; plus local corrections in special cases.

The sea-level isobars in black are based upon pressures corrected for variations of gravity and reduced to sea level by international methods.

The resultant winds are as given in Table VI.

Chart V. Hydrographs for Seven Principal Rivers of the United States. May, 1899.

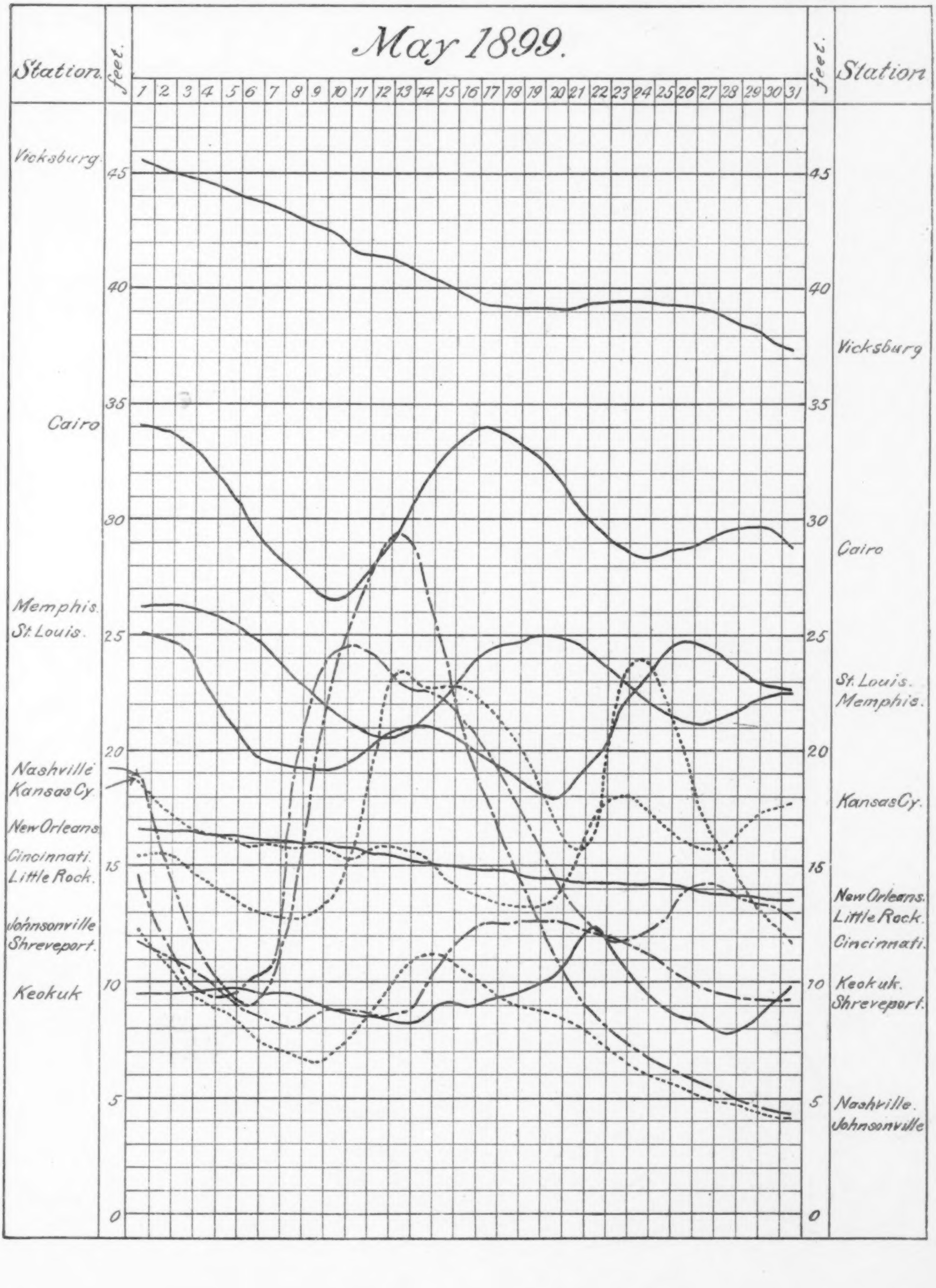


Chart VI. Surface Temperatures; Maximum, Minimum, and Mean. May, 1899.

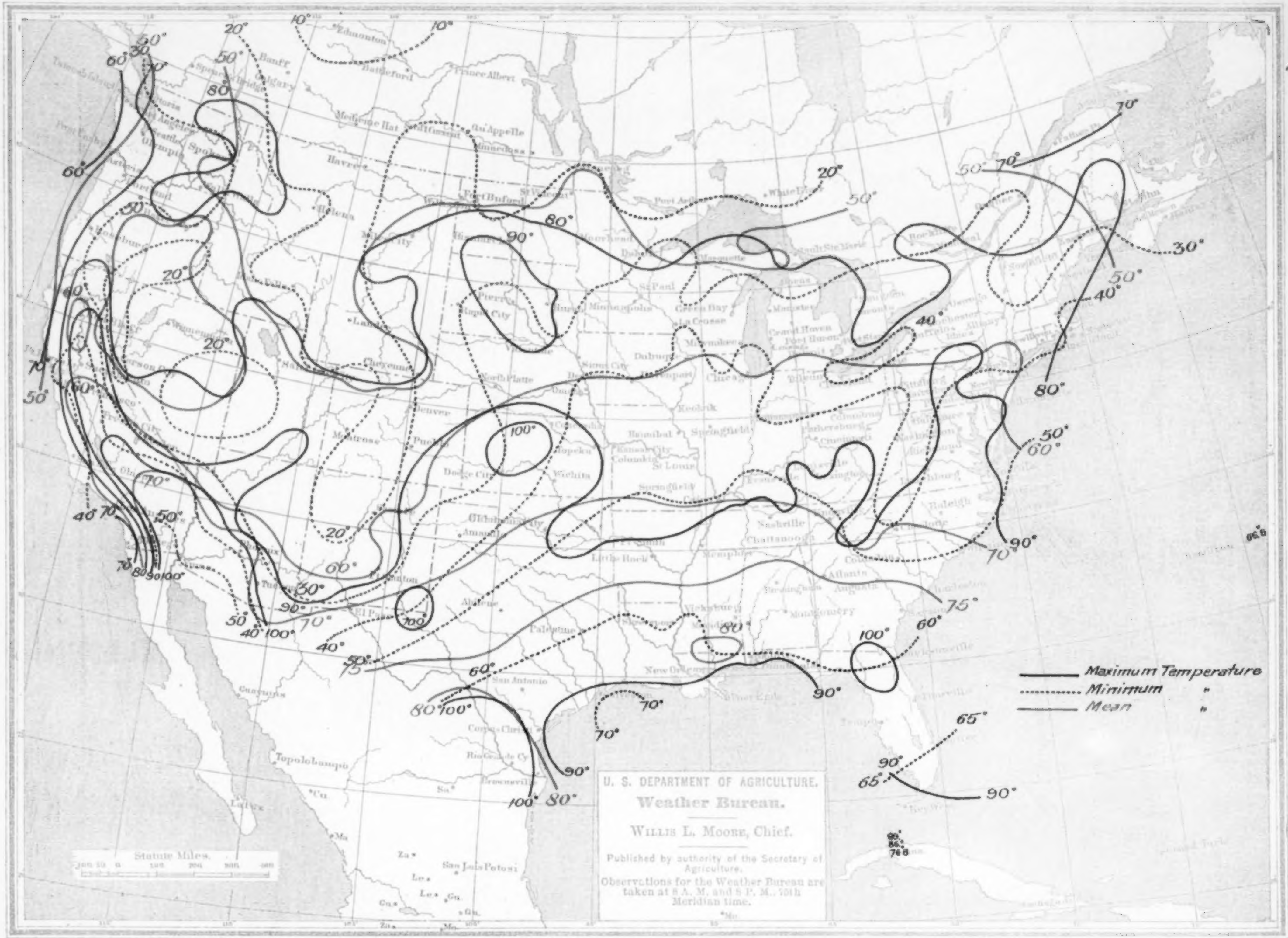


Chart VII. Percentage of Sunshine. May, 1899.

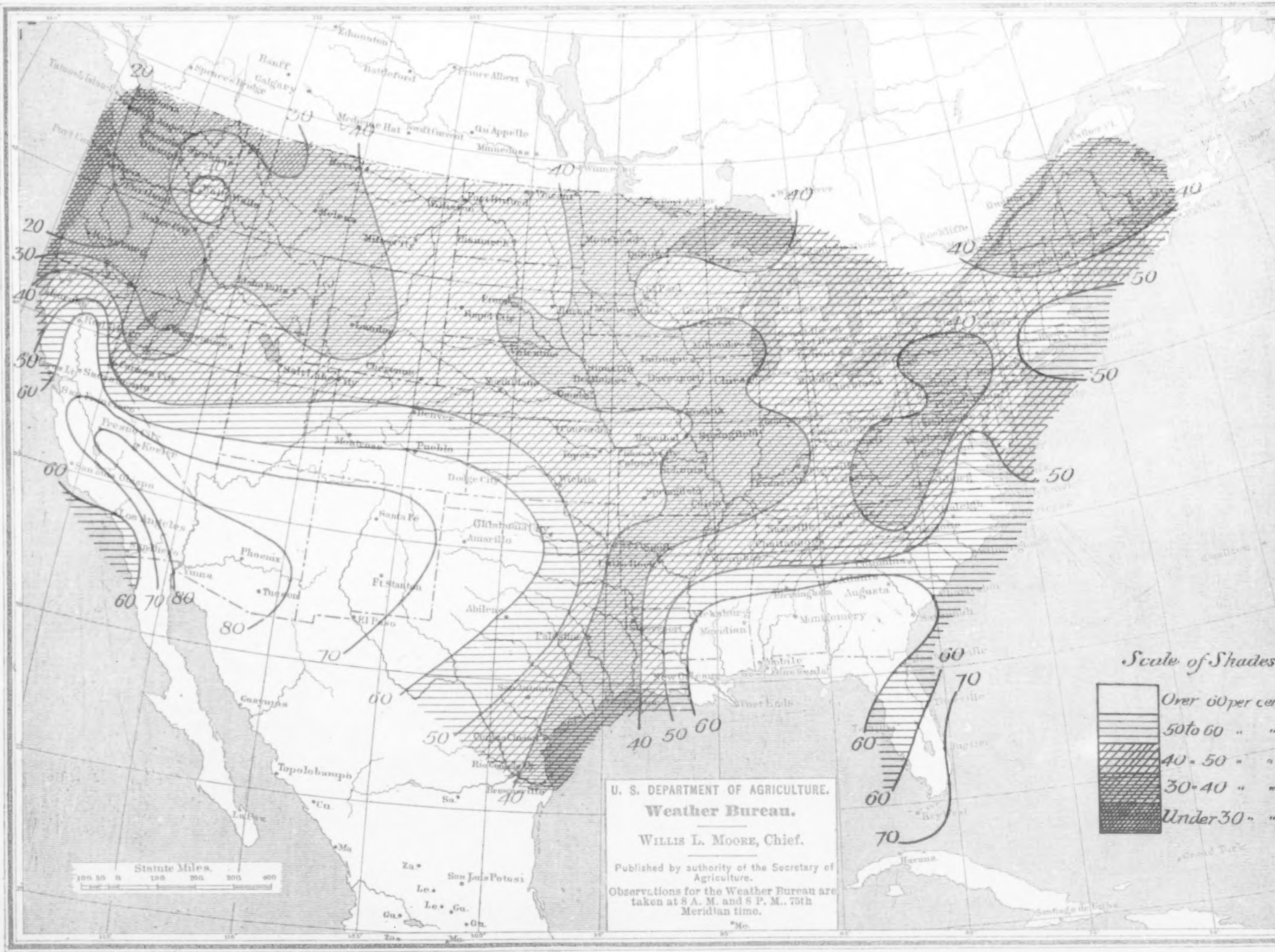
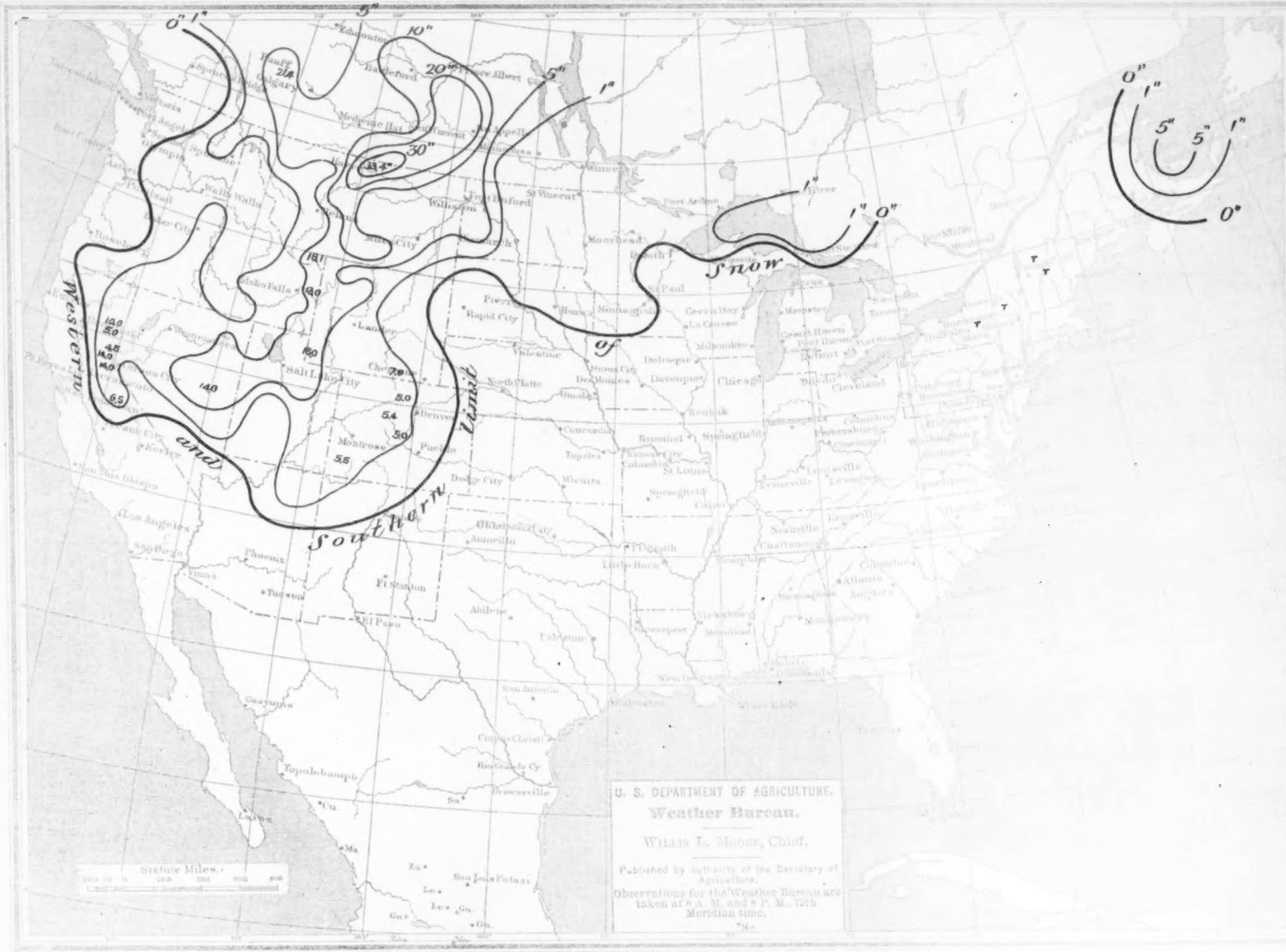
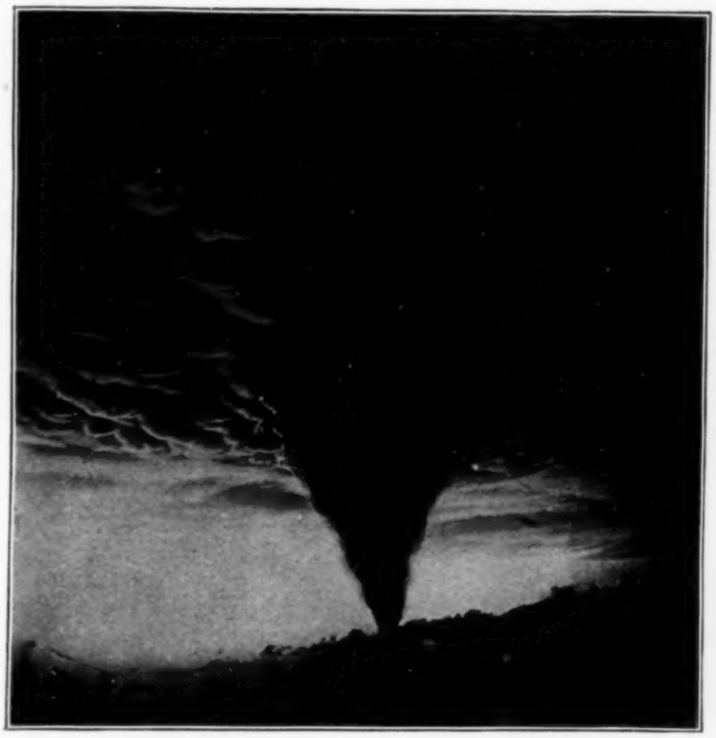


Chart VIII. Total Snowfall. May, 1899.





Waynoka, Okla., May 17, 1898, 6:30 p. m.

Kirksville, Mo., April 27, 1899.

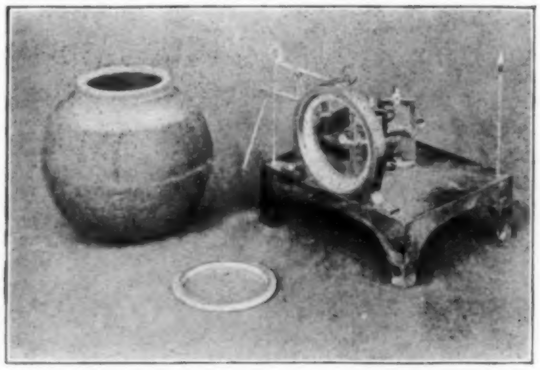


FIG. 2.—The refractometer.

FIG. 3.—Strip of interference bands.

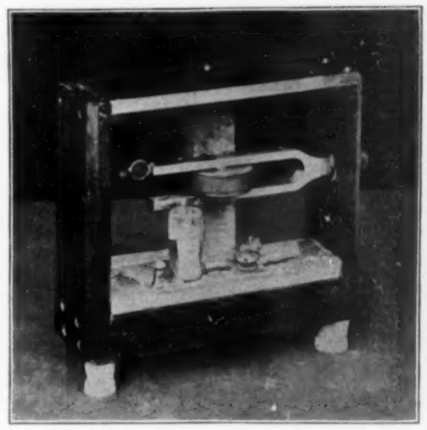


FIG. 4.—Object glass of the telescope, showing heavy frame, electro-magnet, mercury connection, and rubber supports.

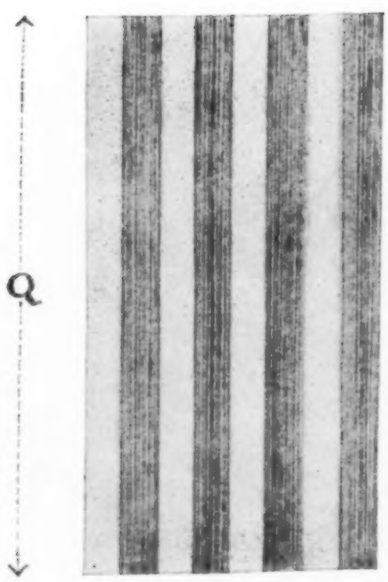


FIG. 5.—Strip of bands elongated by the vibration of the object glass.

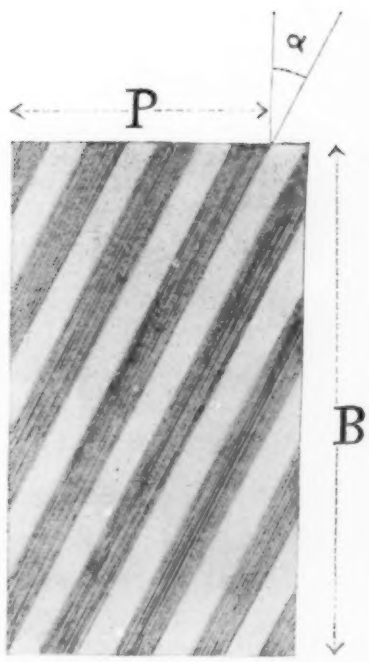


FIG. 6.—The effect of the vibrating object glass upon the elongated bands.

FIG. 7.—Micrometer eyepiece, rotating on its optical axis to measure angles, and provided with tangent screw.

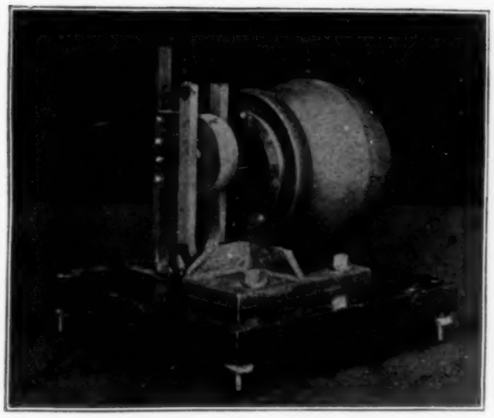


FIG. 8.—The source of tone with the box removed.

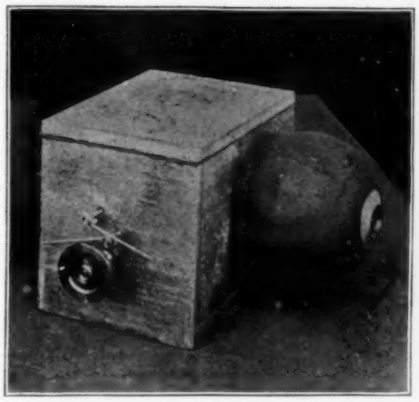


FIG. 9.—Refractometer, boxed and ready for use. The resonator is covered with felt. The screws and levers adjust the mirror, *T*.

FIG. 10.—Welsbach lamp, with metal globe to confine and concentrate the light.

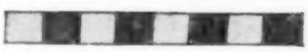


FIG. 11.—The image of the interference bands focused on the film, but greatly enlarged in the figure.

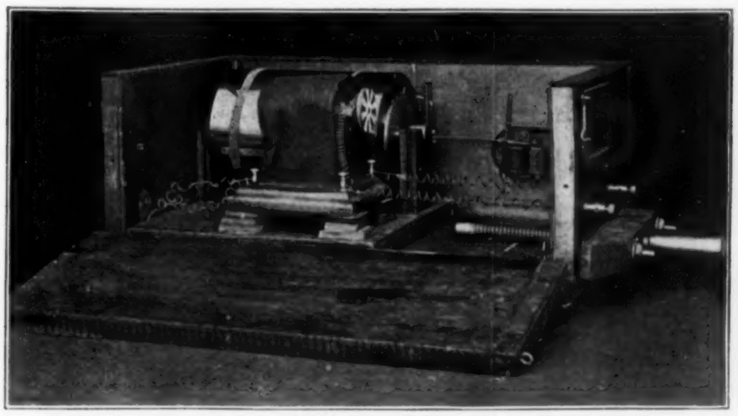
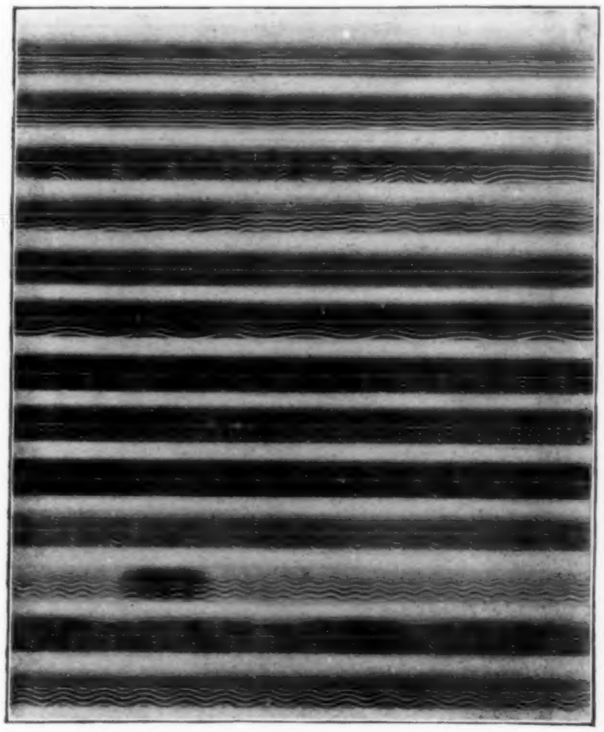
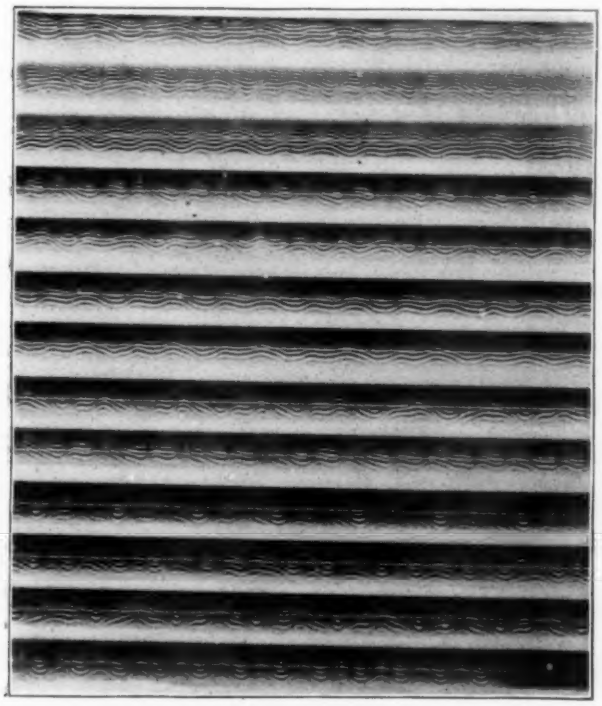


FIG. 12.—The camera, with shutter and lens turned away.



1. Quiet.
2. Fanning I.
3. Fanning II.
4. Noise.
5. Flageolet.
6. Fork C_{128}.
7. Fork c_{256}.
8. Fork c'_{512}.
9. Forks $C + c$.
10. Forks $C + c + c'$.
11. Forks $g + a$.
12. Forks $c + e + g + c'$.
13. Tone source.

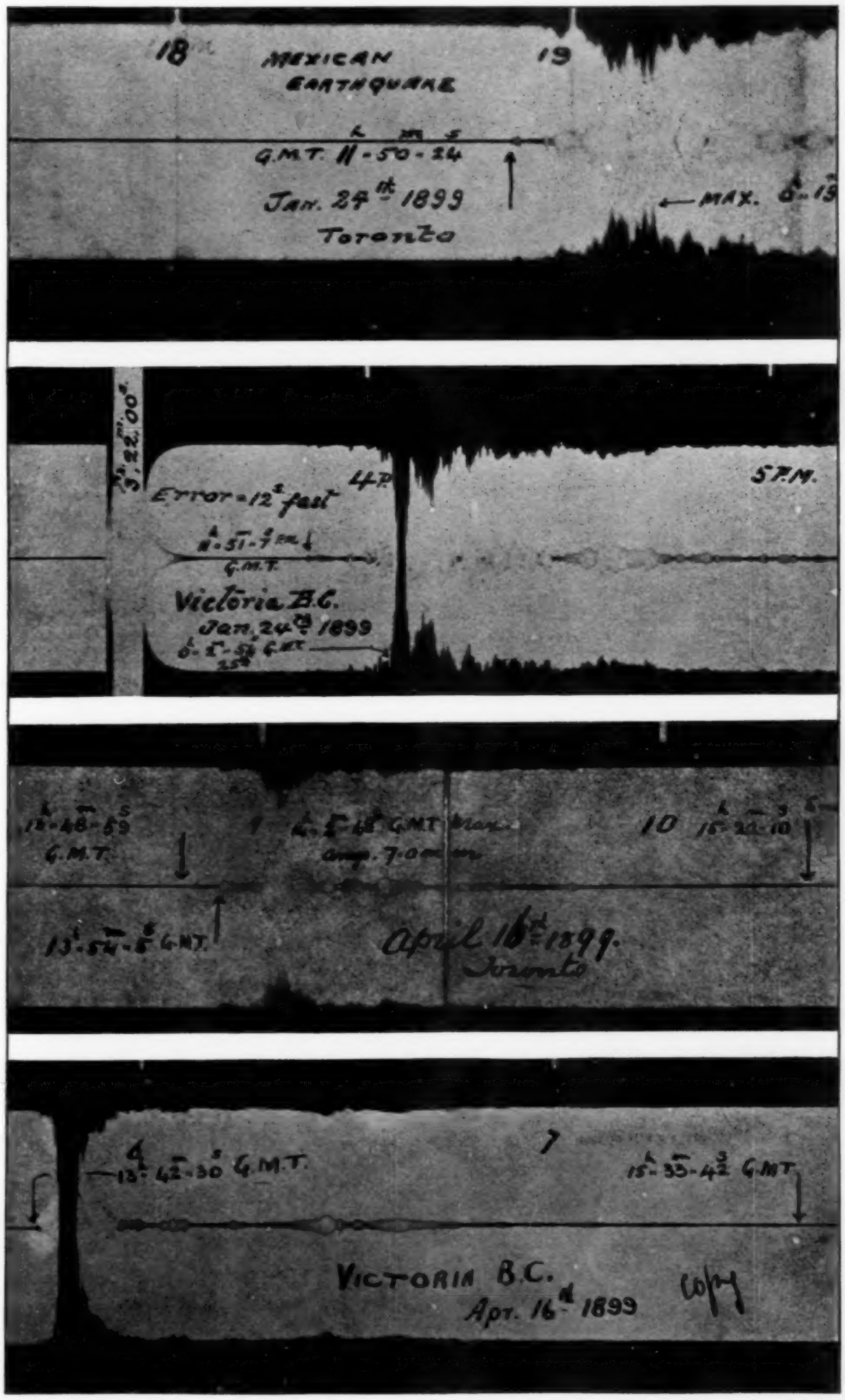
FIG. 15.—Photographs of pure tones and combinations of tones.

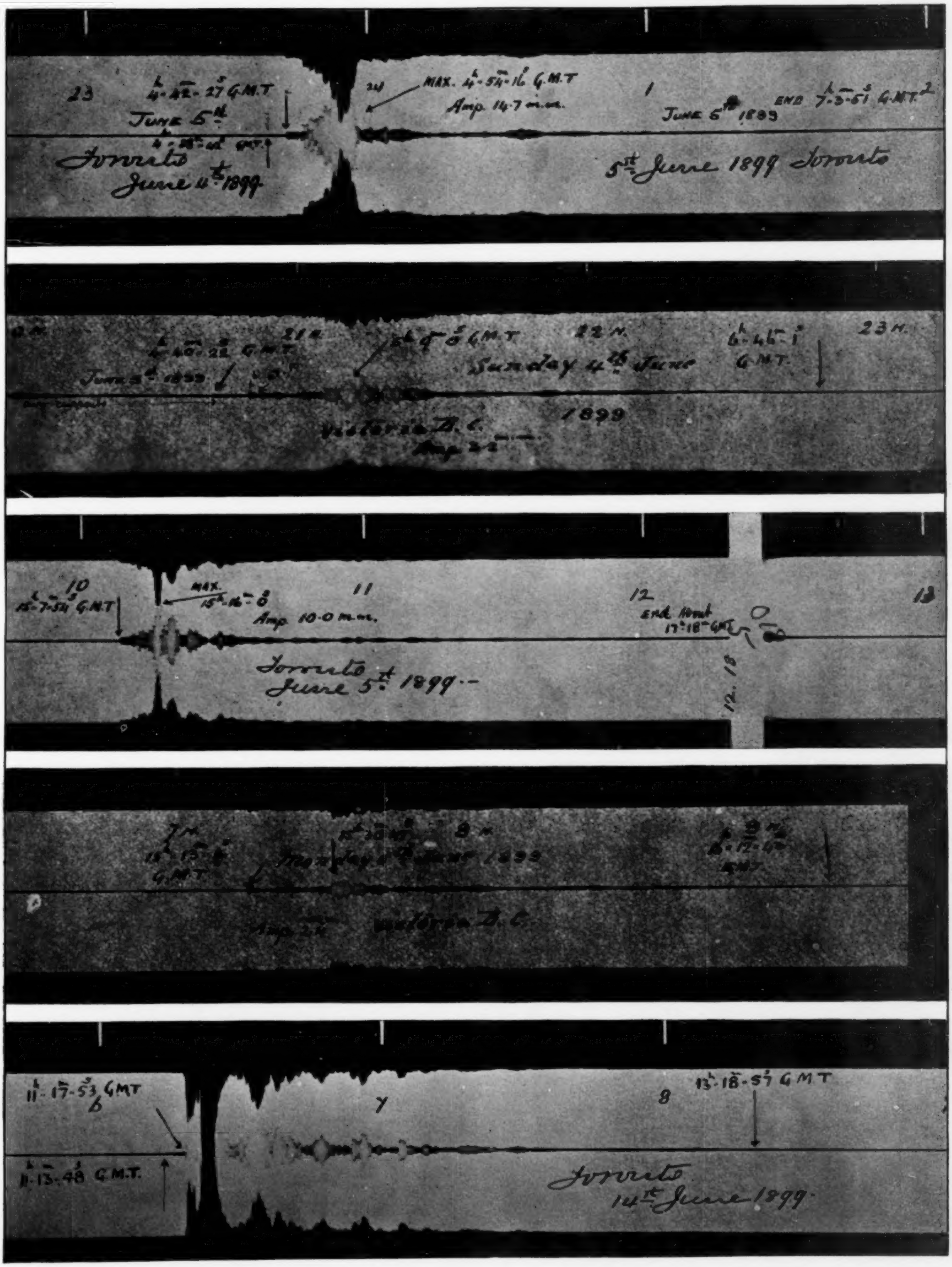


1. (a)h.
2. (o)h.
3. p(oo)l.
4. (a)te.
5. m(ee)t.
6. s(e)t.
7. (a)t.
8. (i)t.
9. (au)ght.
10. (e)re.
11. (u)se.
12. (u)rn.
13. Fork c_{256}.

FIG. 16.—Photographs of vowels.

Plate V. Records Made by Milne Seismograph.




MAX. 4h 54m 16s G.M.T
Amp. 14.7 m.m.
June 5th 1899
5th June 1899 Toronto
Toronto June 4th 1899
Sunday 4th June
1899
Victoria B.C.
MAX. 15h 16m 0s
Amp. 10.0 m.m.
Toronto June 5th 1899.-
Victoria B.C.
11h 17m 53s GMT
11h 13m 48s G.M.T.
13h 18m 57s G.M.T
Toronto 14th June 1899.